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VENUS' FLOWER-BASKET—EUPLECTELLA SPECIOSA.

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(*With a Coloured Plate.*)

THE shores of the Phillippine Islands yield the exquisite object which has been well called Venus' Flower-basket, and which is known to science as a *sponge*, to which the name *Euplectella speciosa* has been appropriately given. The ordinary observer, familiar only with the sponges in domestic use, or with somewhat similar structures of branched and finger-like forms frequently found on the beaches of frequented watering-places, will be much surprised at finding the name of *sponge* applied to the elaborate network of the *Euplectella*, which looks like an exceedingly delicate fabric of some such material as biscuit china, and which might readily be taken for a coral, although an investigation of its structure would show that it was entirely different from any polyp formation. Our engraving represents one of the finest of the British Museum specimens, but the following description is chiefly taken from a specimen in the writer's possession, which he was able, at no small risk of its destruction, to examine more carefully than could be effected in any public institution.

The naturalist groups together a number of bodies varying considerably in appearance, in structure, and in material, under the designation *sponge*. Sponges are, however, all alike in certain general characters. They all consist of a living mass of delicate gelatinous fleshy material, called *sarcode*, and of a framework or skeleton, with certain appendages, which is either horny (keratose), calcareous, or silicious. The common toilet sponge belongs to the horny series, and the Venus' Flower-basket is the most exquisite of the silicious.

Whatever may be the form of the sponge skeleton, or of the spicules of various shapes which belong to it, or are embedded in the soft flesh, it is by, and in, that flesh, that they

are all produced. In the silicious series, the glossy threads, or spicules, have a very small channel running through them, and they are formed, not in one piece, as a glass-blower spins his so-called hair, but by a series of additions, arranged as concentric layers, each layer being a deposit from the living *sarcode*.

In the *Euplectella* the structure bears, at first sight, an aspect of basket-work, and imagination might picture the young mermaidens varying their legendary occupation of combing their sea-green hair, by employing their finny fingers in weaving together the glittering threads of which it is composed. It is, however, not a product of any mechanical plaiting, but of organic life and growth, and a microscopic examination at once distinguishes it from any structure put together by the intertwisting of separate fibres. To view the *Euplectella* under the microscope without breaking it to pieces requires a good deal of trouble, and a little skill; but it is very advisable to examine it in an uninjured condition, as well as to study details of structure in fragments that may be broken off. From the size of the *Euplectella* it cannot be examined if laid across the stage of Ross's large and fine microscope, as that instrument, so admirable in most other particulars, has not enough rack-room to raise a low-power object-glass to the focussing height above so thick an object. Smith and Beck's pattern is superior in this respect, and in our investigation we employed both. To view the *Euplectella* under the Ross binocular, we rigged up a temporary stage of card under the brass stage of the instrument, and then got on pretty well with three inch, and one and a half inch powers. Further examination was made with a monocular Smith and Beck, the delicate sponge being placed across the stage, and supported by a box at each end.

A good specimen, fully grown, of the Venus' Flower-basket will be rather more than a foot long, and about two inches in diameter at its widest end. It takes, as our plate shows, the curve, and somewhat the form, of a cornucopia. At the base it is covered with a quantity of silicious hairs, part of which the natives have a knack of removing before sending it to Europe. The natural position of this sponge is upright, and it probably grows on a soft sea-bed. At nearly equal distances, say from one-eighth to three-sixteenths of an inch apart, vertical bundles of silicious threads rise from the base, and are continued to the top of the structure, and at right angles to these we observe a series of horizontal rows, crossing the former and giving rise to square meshes of considerable regularity. Slanting fibres cross the corners of these squares, and give a more or less rounded appearance to the central apertures;

while from near the base to the top, elegant frills or furbelows rise at their intervals, composed of interlacing fibres. These frills rise gently from the general surface, and stand out from it to a distance of from one to three-eighths of an inch. They have a general disposition to form diagonals to the square meshes, which they cross in graceful undulations. They are wider at the base than at the top, and no doubt materially strengthen the delicate structure which they adorn. In the writer's specimen they are in two sets, one at right angles to the other, and must be regarded as beautiful instances of decoration, arising out of a construction evidently intended for the useful purpose of increasing the resisting power of an extremely light framework.

The first aspect of the *Euplectella*, under low magnification, leads to the notion that the vertical and horizontal bundles of silicious threads are simple cylinders, more or less closely packed together; but a closer investigation shows that they are more complex. It is common to find two or more, as it were, soldered together, and the external ones, especially, frequently throw out branches and prolongations, which form junctions with other threads far and near. These junctions are sometimes smooth, and at others marked by slight rounded prominences. A thread will often proceed for some distance as a simple cylinder, and then divide, either with a bold furcation, or forming two nearly parallel threads, joined at intervals by cross pieces. Many instances may be observed of little projections from such threads looking at each

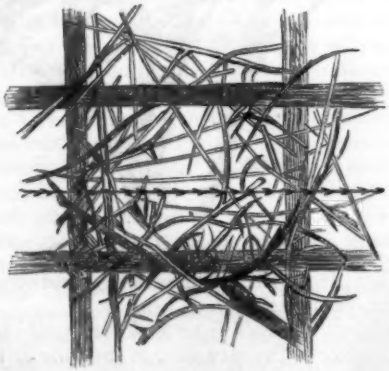

FIG. 1.—Portion of Network of Skeleton of *Euplectella speciosa*, magnified.

other across the narrow gulf, but not quite meeting, as if their growth were arrested or incomplete. The threads that take

slanting directions across the corners of the square meshes are much branched and forked, and frequently spicules with cross heads may be seen. There are also numerous jagged threads, not belonging to the main structure, but appended to it, and often terminating in a knot of recurved hooks, like certain walking-sticks cut from thorns. Spicules, of a more elaborate pattern, probably belong to the sarcode, are perhaps more frequent in rough dingy-looking specimens than in those which have been bleached and cleaned.

Fig. 1 (p. 163.) represents a portion of the net-work, reduced one-half from the original drawing, made with a magnification of about 17, and selected to represent the general character of the threads crossing the square meshes. In this sketch the horizontal and vertical threads are depicted as simple cylinders, which appearance they often present under low powers for considerable distances.

Fig. 2 is a reduction from a sketch made under higher magnification (× 40), from a portion that well shows the way in

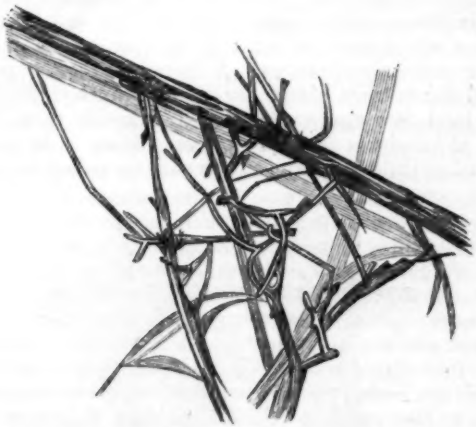

Fig 2.—*Euplectella.*—Magnified portion, showing organic junction of fibre.

which fibres from the main bundles form junctions with fibres springing from other parts.

Fig. 3, reduced one-half from a sketch made with magnification of 17, exhibits the structure of the frills or furbelows.

The top of the *Euplectella* is covered in full-grown specimens, with a network of threads soldered together, and crossing at various angles, making three and four-sided meshes of different sizes.

When single fibres are separated from the *Euplectella*, they are found to possess a considerable degree of elasticity, in this respect resembling spun glass, and they may be bent, to some extent, without breaking. Holding a fibre in a spirit

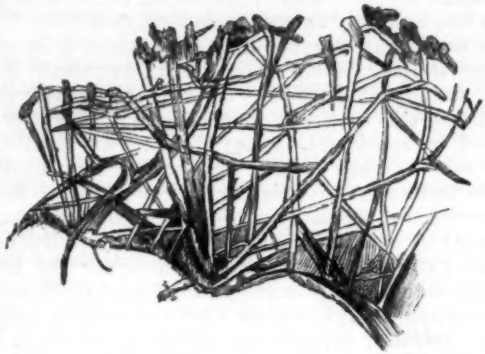

Fig 3.—Frill or Furbelow of *Euplectella speciosa*, magnified.

lamp causes it to split, and fly to pieces, but if the process is carefully managed, and the burnt portion is examined under the microscope, the character of its formation, by the superposition of concentric fibres will be discovered. Likewise, if a number of ends of broken threads be examined, some will be found to exhibit the aspect of a series of tubes, like the draw tubes of a telescope, one entering into the other.

The production of such an exquisite and complicated framework as the Venus' Flower-basket, by precipitation of silex in a film of sarcode, is, in the highest degree curious and instructive. Probably purely chemical laws of precipitation, under certain conditions, combine with those other laws—whatever they may be—which determine the vital processes of the organization.

The base of my specimen has a rounded form, and is shaggy with the white hair-like fibres, amongst which are entangled a mass of minute shells, foraminifera, mud particles, and sundry spicules; but I have not in the base, or anywhere else, found any of the elegant flower-like four-rayed spicules figured by Dr. Bowerbank, and which probably belong to the sarcode, and have been washed away from mine, and other sponges that have been carefully cleaned, in order to exhibit the beauty of the skeleton in a more perfect way.

Towards the base of the writer's specimen the vertical bundles of fibres separate and form a loose mass, readily capable of holding extraneous matter, and anchoring the entire structure. The fibres at this end are all, or nearly all, more or less jagged, so much so that they feel rough to the touch. In this respect they differ from the smoother fibres of the *Hyalonema*, which do not hackle together or combine in any way, but are like a slightly twisted bundle of glass hairs.

The *Euplectella* was supposed, until lately, to be very rare; but now stories are told of its being frequently found and offered cheaply at Manilla. It is to be hoped that some naturalist on the spot will inquire into its mode of growth, and send us specimens, preserved, as far as possible, in their natural state. When covered with sarcode they might be less beautiful than in the artificially-prepared state in which they usually reach us, but many important particulars can only be ascertained by studying the sponge in that condition. When portions of clean *Euplectella* fibres are under the microscope they shine with a glassy lustre with reflected light, and exhibit the transparency of glass hairs when transmitted light is employed. Spicules, properly so called, do not seem to enter importantly in the construction of the frame-work—at least it would be scarcely correct to give that name to very long fibres which have thorny projections, or to other long fibres united by various silicious processes to similar fibres in their vicinity.

The high refractive power of the silicious threads gives rise to the opaque porcellanous aspect which the *Euplectella* exhibits when seen from a little distance. It is the most elegant of known sponges, and will be the delight of judicious collectors, even though a larger supply of specimens should reduce its price.

DRESS ACCORDING TO STATUTE.

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To all who desire to paint accurately on the mental retina a historical picture of the past, the study of the dress in which the byegone people clothed themselves, must be as interesting as the study of the buildings in which they lived, or of any other strictly personal thing belonging to them. Without a knowledge of the kind and quality of the clothes worn by our ancestors, any idea we may form of them as units in the everyday, working world, must necessarily be imperfect; we may read of men, of their sayings and doings, of their lives, and of the effect they had upon the lives of those who were coeval with them; but in the absence of means for bringing vividly before our minds the image of their persons, they will be to us as so many lay figures, entities, not persons, wanting those very essentials which alone enable the historian to create before the mind's eye of his readers a word-picture which shall truly and properly describe the men of the old order. For this reason, if for no other, the study of costume cannot fail to be deeply interesting to the historical student. Does not "the apparel oft proclaim the man?" and is not the garb of a people, especially in certain classes, a pretty sure indication of their style and character? But when it is found that, this reason set aside, the article of dress appears again and again in the statute-book as a subject not unworthy the consideration of the legislative wisdom of the country, one feels bound to inquire somewhat closely concerning it, placed as it is on the same level with great questions of finance, religion, trade, and war. As a matter of fact, the article of dress does appear constantly in the statute-book as a subject of legislation, and it is the purpose of the writer of this article to pursue somewhat closely an inquiry into the sartorial question which appears to have exercised our forefathers so severely. In doing so he will be guided solely by the light which the statute-book affords, assisted where that fails by those equally trustworthy records, written for the most part by contemporaneous authors, and now published anew to the world by the Master of the Rolls, after a sleep, in which their existence was endangered, for several centuries in the old libraries of our oldest colleges.

Long before the political economists of the day took notice of the clothes in which men dressed themselves, the clergy

had had the subject under their consideration, and had not ceased to inveigh against extravagance of apparel, not so much because it was wasteful, as because it was the child of personal vanity, and as such opposed to the simplicity of the Christian rule of life, and to the direct teaching of Him who compared Solomon in all his glory to the lily of the field, and found him wanting in beauty beside it. Again and again the monkish writers speak earnestly and heartily against the fops of their day, mentioning as a matter of the gravest importance that they wore tunics with deep sleeves, and mantles with long trains, like women; that the peaks of their shoes were of enormous length, stuffed with tow, and twisted into fantastic shapes; that their hair, divided in front, fell down upon their shoulders in ringlets, having also false curls added, to make them look more like women. "Effœmenati" is the title by which the monks call them, and they do not hesitate to attribute to them vices of the most abominable kind. Some allowance should doubtless be made for Saxon monks, who wrote about Norman gallants, and later on, when this national distinction was done away, for the antipathy which the children of light might be supposed to have for the moth-like children of this world; but Norman monks also declaimed against Norman gallants, and the clerical anger, whether found in Norman or Saxon breast, was, beyond all question, genuine; though it sometimes went above the mark, and made itself ridiculous by the extravagant way in which it beat the air. That it was genuine is abundantly proved by many things, and notably by the sermons, poems, speeches, and exhortations of divers kinds, with which the clergy belaboured their flocks at the time the great pestilence, known as the Black Death, swept away more than half the population of England. On this occasion it was many times preached that the sinful wastefulness of men and women in respect of their dress was among the chief offences for which the wrath of God had come upon the land. Giving the go-bye to his wrath because of the bad drainage, the filthy condition of houses, the confined and unwholesome streets, and the other accessories of fever, the clergy fixed upon excess in apparel as being most displeasing to God. Against silk hoods and party-coloured coats, deep sleeves, and narrow waists; against garments which were indecently short, according to the censor's notions of decency; against pointed shoes and bushy beards, the voice of the clergy was loudly raised in notes of entreaty and warning. Women as well as men came in for their share of blame, and bold, unwomanly imitation of men's attire drew forth as eloquent denunciations as the unmanly practice of men who aped the dress of women.

The following passage from the "Eulogium Historiarum"—an anonymous but trustworthy chronicle, not only testifies to the extravagance of dress in the year 1361, in spite of the warning given twelve years before by the Black Death, but mentions the names of some of the garments most affected by the dandies of the period, and gives a very fair description of the dresses commonly worn. The pious, if somewhat narrow-minded, writer finishes his account by expressing a fear "lest the dire punishment of the Lord should follow such wickedness."

"In this and the preceding year the whole people of England went mad in the matter of ornamental dress; firstly, they wore large over-tunics, cut short at the loins; some of these were as long as to the heel, not open in front as becomes men, but distended in pleats about the arms, after the manner of women, so that they who see them from behind must think them to be women rather than men. This garment is called, and rightly, in the vulgar tongue, 'goun,' and well is it so called, for 'goun' is derived from 'gounyg,' which, properly speaking, is 'wounyg,' or 'open shame.' They have also little caps fastened under the chin, buttoned after the manner of women, and having at the top part, in the round, philacteries studded with gold, silver, and precious stones.

"They have also another silken garment, called a 'paltok,' which is rather suitable for a cleric than a layman; yet is it said in the book of Kings that Solomon in all his life never wore such a thing. They also have drawers in two parts, stiffened, which they fasten with braces to their 'paltoks,' and which are called 'harlots.' . . . . They have gold and silver belts, enriched at great cost, the best being of the value of twenty marks; inferior ones, such as esquires and other freemen would wear, at the price of a hundred shillings, or five marks, or even twenty shillings, and all the while the buyers have not twenty pence in their purse."

The writer speaks of those who wear such things as being "idlers and vapourers rather than men, actors than knights, mummers than esquires. At court they are lions, but hares in the field; they are slow to give, swift to take; eager for trifles, but wearied by prayer!"

In the course of time the professors of a political economy, which saw in the impoverishment of the extravagant an injury to the nation at large, justifying its conclusion, perhaps, by the fact that much of the money spent in finery went out of the country, which received nothing valuable in return, and appealing to the experience which taught that an example of prodigality in the upper classes is sure to be followed more or less ruinously through all the minor classes in the community,

took notice of excess in apparel, and joined with the professors of religion in condemning those who enlarged the hem of their garments, and carried the price of a county in the clothing that was on their backs.

In the fifteenth year of Edward III., there was, as we learn from the "Brute Chronicle" (attributed to Douglas of Glastonbury), a great rage for dress, and the fashions of the same:—"And in this tyme englisshe men so myche haunted and cleved to y^e^ woodness and foly of y^e^ straungers, y^t^ yey ordeyned and chaunged hem every yeer diverse shappes and desgisynges of clothyng." This is only the record, simple and terse, of what had been taught and preached against for many years previously, and is the straw showing which way the wind blew when the statute, passed towards the end of Edward's reign was framed. By the thirty-seventh year of Edward III. the Parliament, or grand council, that governed the land, was ready to consider a project which should have the effect of checking the extravagance of the people in the matter of dress, and in that year accordingly, they agreed to a law which they fondly hoped would have that effect. They saw the money which fops spent—the money which might possibly be their own, to do as they liked with, or which it might be, was wrung "from the hard hands of peasants by indirection," going steadily out of the country, and they saw the youth and promise of the land "rot inwardly, and foul contagion spread;" they saw no prospect of manufactories, worked by native industry, rising in the land, nor did the habit and custom of the age suggest a policy which would give birth to such manufactures. Perhaps, too, in an assembly composed of those who, for the most part, were fine birds without needing fine feathers to make them so, the fact of extravagance in plumage was so senseless, and withal so serious, observable as it was, not only in the upper, but in the inferior classes also, that *ipso facto*, they were resolved to put a legislative curb upon it. Accordingly we find an Act passed in 1363—the Act 37 Edward III., c. 8, to restrain "the outrageous and excessive apparel of divers people, against their estate and degree," which is the first of the series of sumptuary laws, if we except a law made in the eleventh year of Edward III., by which the use of fur was prohibited to all persons, except the King, the Royal family, and those who possessed £100 a year derived from land.

The passage already quoted from the "Eulogium Historiarum" throws some light on the circumstances under which the Act was passed. The following are the principal provisions of the statute, with its brief preamble:—

"1. For the outrageous and excessive apparel of divers

people, against their estate and degree, to the great destruction and impoverishment of all the land: it is ordained that grooms, as well servants of lords as they of mysteries and artificers, shall . . . . have clothes for their vesture or hosing whereof the whole cloth shall not exceed two marks (26*s.* 8*d.*), and that they wear no cloth of higher price, of their buying nor otherwise, nor nothing of gold, nor of silver embroidered, aimeled, nor of silk, nor nothing pertaining to the said things; and their wives, daughters, and children of the same condition in their clothing and apparel, and they shall wear no veile, ne kerchief, passing twelve pence a veile.

2. People of handicraft and yeomen are not to wear cloth of more than forty shillings the whole of it, 'by way of buying nor otherwise,' nor may they wear precious stones, 'nor cloth of silk nor of silver, nor girdle, knyf harnessed, ring, garter, nor owche, ribband, chains, nor no such other things of gold nor of silver,' nor any embroidered work or silk. The wives and children of such persons to be liable to same restrictions, it being also expressly forbidden them to wear a kerchief of silk, or of anything but '*yarn made within the realm*, nor no manner of furr, nor of budge, but only lamb, coney, cat, and fox.'

3. Esquires, and all gentlemen under the estate of a knight, and not having land or rent of the value of £100 a year, were to wear suits costing no more than 4⅔ marks (£3). They were not to wear any 'cloth of gold, nor silk, nor silver, nor no manner of clothing embroidered, ring, broche, nor owche of gold;' they were to use 'nothing of stone, nor no manner of fur.' The wives and daughters of these gentlemen were under similar restraint, an injunction being added against their having 'any turning-up or purfle.' But esquires having two hundred marks a year and upwards in land or rent might 'take and wear clothes of the price of five marks (£3 6*s.* 8*d.*), the whole cloth, and cloth of silk and of silver, ribband, girdle, and other apparel reasonably garnished of silver. Their wives and children might also wear 'furr turned up of miniver, without ermine or letuse,' but they might not wear any precious stones, except upon their heads.

4. Merchants, citizens, and burgesses, artificers, people of handicraft, as well within the City of London as elsewhere, having goods and chattels to the value of £500, they, their wives and children might dress as esquires, etc., and their belongings, who had 'land to rent to the value of £100 by the year;' and those who had goods and chattels to the value of £1000 might dress as esquires and gentlemen who had rent in land to the extent of £200 a year.

5. Knights who had land or rent within the value of £200

by the year (?) might wear six-mark cloth, but 'of none higher price.' They might not wear cloth of gold, nor cloak, mantle, or goun that was 'furred with miniver,' nor sleeves of ermine, nor anything that was set with precious stones, excepting the head-dress; they were not to use any 'turning up of ermines, nor of letuses, ne clieres.' All knights and ladies having land or rent exceeding the value of 400 marks by the year, and not more than £1000 a year, might wear what they liked, except ermine and letuse, and apparel adorned with pearls and precious stones, though they might wear jewels in their head-dresses.

6. All clerks whose degree in college or church, and the clerks of the king whose position required the use of fur, might do according to the constitution of their society. All other clerks having 200 marks a year out of land might do as knights having the same rent; and clerks having less than this amount from rent were to be subject to the same restriction as esquires with £100 a year of rent. It was also provided that 'all knights and clerks who by this ordinance may wear furr in winter, shall wear lawn in summer.'

7. Carters, ploughmen, drivers of the plough, oxherds, cowherds, shepherds, deyars (dairymen) and swineherds, and all other keepers of beasts, threshers of corn, and all manner of people of the estate of a groom attending to husbandry, and all other people that had not forty shillings of goods, "shall not take nor wear no manner of cloth, but blanket and russet (wool) of twelve pence; and shall wear the girdles of linen according to their estate; *and that they come to eat and drink in the manner as pertaineth to them, and not excessively.*"

The penalty provided as the sanction to this elaborate law was forfeiture to the king of all the apparel worn "against the form of this ordinance."

There seems to be some doubt whether this statute was not repealed the year after it was passed, though Hawkins and several other editors of the statutes are of opinion that it was not repealed till the 24 Hen. VIII., c. 13, and finally and completely by 1 Jac. I., c. 25. There is certainly in the words of the short second chapter of the first statute passed in 38 Edward III. something more than a suggestion that the law of the previous parliament was meant to be repealed, but the meaning is not clear, and the wording being very ambiguous, any conclusion arrived at from it must be very far from satisfactory. The preamble to the first sumptuary law of Edward IV., which is given further on, would lead one to suppose that Edward III.'s statute had not been repealed, but had only been inoperative because it had not been put in action.

That a law of the kind should have been inoperative cannot be a matter of surprise to us moderns, who not only have the light of experience to teach us the futility of such laws, but who approach the subjects of them in a spirit altogether different from that which possessed our ancestors. They, however, were perfectly honest in their wish to stop the waste of unproductive spending, and they believed the measure they agreed to would attain for them their wish. Very short experience served to convince them, that whatever law might put an end to waste and prodigality in dress, the law they had made would not do so. The statute was evaded, was set at naught openly, those who should have been most jealous to guard it in its integrity setting the example of driving right through it. The undefined sanction of the law, and the want of proper machinery with which to work it, might have done something towards making the statute a dead letter, but the primary cause of the disregard with which it was treated was to be found in that peacock vanity of human nature which loves to see itself in gay clothing, and in motley wear to "play fantastic tricks before high heaven."

Within twenty years after the passing of the statute, at a time, certainly, when the sun of Edward III. was about to set, and that of a gay, glitter-loving prince was about to rise, we find that excessive richness in clothing and appointments, and the vagaries of the fashions, again attracted the attention of writers and public men, who, both cleric and lay, including Chaucer, inveigh most strongly against them. A curious poem, written in alternate lines of English and Latin, upon the corruptions of the times, by an unknown author, mentions many of the extravagancies of the period. Dandies wore stuffing on their shoulders to make them look broader than they were made by God. They wore high and wide collars, which made their necks look as if ready for the axe; and the long spurs on their heels, and the long pointed shoes stuffed beyond the toes, and fastened by little silver chains to the knees, prevented them from kneeling at prayer time. They could not bend their knees but with difficulty; when other men knelt, offering prayers to Christ, these stood at their heels, not able to bend their legs. They avoided bending, lest they should damage their hose. Here is a specimen of the ballad, and the passage of it from which the above information is gathered:—

"Bredder than ever God made,
humeri sunt arte tumentes;
Narowe they be, they seme brode,
vana sunt hoc facite, gentes.
They bere a newe fascion
humeris in pectore tergo;

Goddes plasmacion
non illis complacet ergo.
Wyde coleres and haye
et gladio sunt colla parata;
Ware ye the prophecye
contra tales recitata.
Long sporys on her helys,
et rostra fovent ocrearum.
* * * *
Qwen oder men knelys,
pia Christo vota ferentes,
Thei stond at here helys,
sua non curvare valentes.
For hortyng of here hosyn,
non inclinare laborant;
I trowe, for here long toos
dum stant feriatiter orant."

Other writers mention, in language equally strong, the shortcomings and excesses of gallants' clothing at this time. The author of the poem on the deposition of Richard II., in the first volume of the "Political Songs and Poems" (published by the Master of the Rolls), thus speaks of the unscrupulous thriftlessness and folly of the courtiers of that prince. He says they beg and borrow

"of burgeis in tounes
ffuris of ffoyne
and other ffelle (skin) whare,
and not the better of a bean
thous they boru evere.
And but if the slevis
slide on the erthe
thei wolle be wroth as the wynde,
and warie hem that it made;
and zif it were elbowis
adoun to the helis,
or passinge the knee,
it was not accounted;
and if Pernelle preisid
the plytis bihynde (the pleats behind)
the costis were accountid,
paye whan he myzth.
* * * *
and if Ffelice ffonde
ony ffaute thenne of the makynge
yt was ysent sone
to shape of the newe."

The writer also speaks of "a wondir coriouse crafte" lately introduced, whereby the cloth was slashed "alle to pecis," so that seven good sewers could not in six weeks sew up all the seams if they tried.

Chaucer, writing De Superbiâ, in the "Persone's Tale," written about the year 1392–3, says, "Seint Gregoire saith that precious clothing is coupable for derthe of it, and for his

schortnes, and for his straungeness and disgisines, and for the superfluite, or for the inordinat skantnes of it; allas! many man may sen as in oure dayes, the synful costlewe array of clothing, and namely in to moche superfluite, or elles in to disordinat skantnes.

"As to the firste synne in superfluité of clothing, which that makid is so dere, to harm of the poeple, not oonly the cost of embrowding, the guyse endentyng or barring, swandyng, palyng, or bendying, and semblable wast of cloth in vanité; and ther is also costlewe furring in here gounes, so mochil pounsying of chiseles to make holes, so moche diggyng of scheirs, for with the superfluité in lengthe of the foresaide gounes, traylinge in the donge and in the myre, on hors and eek on foote, as wel of man as of womman, that al thilke trayling is verraily (as in effect) wasted, consumed, thredbare, and rotyn with donge, rather than it is geven to the pore, to gret damage of the forsaide pore folk, and that in sondry wise. . . . . To speke of the horrible disordinat scantnes of clothing as ben these cuttid sloppis or anslets, that thurgh her schortnes ne covereth not the schamful membre of man, to wicked intent."

It seems that the tightly-fitting dress was considered to be very wicked; the same was thought of a practice in vogue, by which the clothing of the body was party-coloured, being half of it red and the other blue, or of any other colours. The "Persone" is not less severe with women than with men: "Now, as of the outrageous array of wommen, God wot, that though the visage of some of hem seme ful chaste and debonaire, yit notifye they in here array of attyre, licorousnesse and pride."

An anonymous writer on the corruption of public manners in the reign of Henry VI., begins his poem by an address to

"Ye prowd galonttes hertlesse,
With your hyghe cappis witlesse,
And your schort gounys thriftlesse,
Have brought this londe in gret hevynesse.

"With youe longe peked schone,
Therefir your thrifte is almost don,
And with your long here into your eyen (eyes),
Han brought this land to gret pyne."

Though these attacks were made from time to time on the extravagance and folly of the day, no legislative action was taken for a hundred years after the passing of the first sumptuary law. From the pulpit the clergy denounced those habits which they believed would call down the wrath of God upon the land, and less extensively, by means of written books, they warned the people; but the law already in the statute-

book being inoperative, no fresh law was enacted, embracing the whole subject of dress, till the third year of Edward IV. After the troubles in Richard the Second's reign, an act was passed, forbidding husbandmen and labourers to wear sword, buckler, or dagger, but this was not so much in restraint of extravagance as a police regulation, being tantamount to an order for the disarming of those who had lately been so troublesome and formidable. A statute of the 20 Richard II. also particularized those who only might wear another's livery, but this too was rather meant to put a stop to those Capulet and Montagu faction disturbances, which were so rife among the followers of the English noblemen.

The 3 Edward IV., c. 5, recites, "Item prayen the Commons in the said Parliament assembled to our said sovereign lord the king to reduce to his gracious remembrance that in the time of his noble progenitors divers ordinances and statutes were made in this realm of England for the apparel and array of the Commons of the said realm, as well of men as of women, so that none of them ought to use nor wear any inordinate and excessive apparel, but only according to their degrees, which statutes and ordinances notwithstanding, for default of punishment and putting them in due execution, the Commons of the said realm, as well men as women, have worn and daily do wear excessive and inordinate array and apparel, *to the great displeasure of God and impoverishing of this realm of England, and to the enriching of other strange realms and countries to the final destruction of the husbandry of the said realm.*" It is then ordered that no knight under the degree of a lord, nor his wife or child, shall "wear any manner cloth of gold, or any courses wrought with gold, or any furr of sables," under a penalty of £20. No knight bachelor, nor his wife, to wear "cloth of velvet upon velvet," except such knights as be of the Order of the Garter; and none but a lord to wear purple silk, under a penalty of £10.

2. No esquire or gentleman under the degree of a knight to wear any "velvet, satin branched, nor any counterfeit cloth of silk resembling to the same, or any courses wrought like to velvet or to satin branched, or any furr of ermine."

3. No man having less than £40 a year to wear any "furr of martrons (Funes), letuse [pure gray or pure myniver]."

4. No widow having less than £40 a year to wear any "coverchief whereof the price of a plite shall exceed the sum of iij shillings, four pence."

5. Persons with less than forty shillings a year were not to wear any "fustian, bustian, nor fustian of Naples, scarlet cloth in grain, nor no furr, but black or white lamb." Yeomen were

forbidden to use "any bolsters or stuffing of wool, cotton, or cadas, or any stuffing in his doublet, but only lining according to the same." Servants also were not to wear cloth which cost more than "two shillings the broad yard."

6. "And because that coverchiefs daily brought into the realm do induce great charge and cost in the same, and in effect in waste," it is forbidden to sell within the kingdom "any laun, niefles, umple, or any other manner of coverchiefs whereof the plite shall exceed ten shillings."

In order to promote the use of a dress which should be in the popular opinion more decent, and which should not involve the objections pointed out by the critics in "The Persone's Tale," and in the various political poems that have been quoted, at the same time that perfect liberty to do as they liked was reserved to the persons most likely to offend, it was ordered by this statute that no person under the degree of a lord should wear any goun, jacket, or cloak, "unless it be of such length that the same may cover his privy members and buttocks," nor wear "any shoes or boots having pikes passing the length of two inches."

In the year 1482 the previous sumptuary laws were repealed, and the 3 Edward IV., c. 5 was re-enacted with greater stringency, the reason given in the preamble being that, through excess and wastefulness of apparel, the "said realm was fallen into great misery and poverty, and like to fall into more greater, unless the remedy therefor be sooner."

It is needless to adduce the evidence of writers and chroniclers of the time to show that male and female vanity managed to evade the law, though it were never so stringent. There was a difficulty about bringing the delinquents *coram judice*, none but the ill-natured, or the pedantic, or the crotchety, would inform against them, and magistrates, unless they were of the same kidney with the prosecutors, would be slow to punish what was, after all, but the harmless expression of a vanity that was shared by judge and prisoner alike. As a matter of fact, the law was continuously disregarded, as in the nature of things it must have been; and though Empson and Dudley doubtless drew some of the fines, with which they enriched their master's treasury, out of the pockets of the dandified, and those who got themselves up regardless of cost—following the example set them by their master in the case of the Earl of Oxford and his liveries—the administrators of the law generally winked at the struttings of the jays who decked themselves in peacock's feathers.

Henry the Eighth, however, in the first year of his reign, tried his hand at a statute which was meant to carry out the objects attempted in vain by the acts of his predecessors, and

his doing so was quite in keeping with the rest of his domestic policy, which strove to give him a power and domination that should be felt in every relation, no matter how trifling or how personal. 1 Henry VIII., c. 14, "An Act agaynst wearing of costly apparell," forbad any but the king and his family to wear cloth of gold, of purple colour, or of silk of the same. None less than a duke might wear any cloth of gold of tissue; none less than an earl might wear sables; and none less than a baron might wear cloth of gold or silver, or "tynsen satten," or silk or cloth mixed or embroidered with gold or silver. None less than a lord or knight of the garter might wear woollen cloth made out of the kingdom, or wear any velvet of "the colour of crymesyn or blewe;" none less than a knight (excepting some of the royal servants and the judges) might wear velvets and furs; "nor no person (might) use or wear satten or damaske in their doblett, nor sylke or chamlett in their gowens or cootes, not having for life £20 a year in lands;" no one "under the degree of a gentleman" might wear "foreign fur"; no servant was to be dressed in cloth that cost more than twenty pence a yard. Knights only might wear "guarded and pinched (pleated) shirts of linen cloth." Servants in husbandry were not to have cloth of which the piece was more than ten pence a yard. This statute was not to apply to women, ambassadors, heralds, players in interludes, nor to soldiers.

In the sixth year of Henry another and more stringent law was passed, which, having been found insufficient, was repealed, and re-enacted more thoroughly in the following year. The preamble of this statute recites, that "Forasmuch as the grette and costly array and apparel used within this realm contrary to good statutes thereof made, hath been the occasion of great impoverishing of divers of the king's subjects, and provoked divers of them to rob and to do extortion, and other unlawful deeds, to maintain thereby their costly array." In the 24 Henry VIII., another sumptuary law was passed, by which the costume of everybody was regulated, as it was supposed, definitely; and it did suffice, as far as any law could suffice, till the reign of Philip and Mary, in the first year of whose reign was passed "An Acte for the Reformācon of Excesse in Apparaile," by which the restraints on dress were made less comprehensive, though imprisonment was added to fine as a means of enforcing compliance with such orders as were retained. There was also a clause not unworthy the sex of the sovereign who assented to the law:—"Provided also that women maye weare in their cappes, hattes, gyrdells, and hoodes as they or any of them might use and weare lawfully before the making of this Act." An Act of Elizabeth, intended, it is imagined, to

check unthrift, declared that any one who sold foreign apparel to persons having less than £3000 a year in land or fees, except for ready money, should lose the price of the same, no matter how it might have been secured.

By the 13 Eliz., c. 19, the last of the sumptuary laws, it would seem that though caps had been at one time a general article of attire, they had gone greatly out of fashion, causing thereby a grievous falling off in the cap-making business. This business seems to have been powerful enough to procure, as did the button-makers at a later date, special legislation in its favour. The above-named Act recites the evils that have arisen from the decay of the cap-making trade by the disuse of caps, and requires that every one above six years of age, except ladies, peers, and those who have twenty marks a year out of land, or who have "borne any office of worship in any city, borough, town, hamlet, or shire," shall wear "upon the Sabothe and Holy Daye . . . one cappe of woll knytt, thicked, and dressed in England," or be fined three shillings and four pence a day. This act was, however, repealed in the thirty-ninth year of the queen.

These various laws regulating the kind and quality of the apparel which men of all sorts and their belongings might wear, continued to be in existence, if not in operation, till the advent of James the First to the throne. By the 1 James I., c. 25, they were repealed, and folks were left to follow the bent of their own fancy, being bounded only by the same restraints as kept them from entering into any other extravagance. Not any attempt has since been made to revive sumptuary laws, though so late as the seventh year of George I. an Act was passed "to preserve and encourage the woollen and silk manufactures of this kingdom, and for more effectually employing the poor by prohibiting the use and wear of all printed, painted, stained, or dyed callicoes in apparel or household stuff, furniture or otherwise," excepting only "such callicoes as shall be dyed all blue." In the same session was passed the famous Act which prohibited the use of any buttons made of cloth, serge, or other stuffs, the object being to keep up the monopoly which workers in silk and mohair had established.

THE GRAVE-MOUNDS OF DERBYSHIRE, AND THEIR CONTENTS.

BY LLEWELLYNN JEWITT, F.S.A., ETC., ETC.

THE ancient grave-mounds of Derbyshire lie, for the most part, scattered over the wild, mountainous, and beautiful district known as the High Peak—a district occupying nearly one-half of the county, and containing within its limits many towns, villages, and other places of extreme interest. It it true that here and there a grave-mound exists in the southern or low-land portion of the county, but, as a rule, they may be almost said to be peculiar, and confined, to the northern, or hilly, district, where in some parts they are very abundant. Indeed, there are districts where there is scarcely a hill, even in that land where,

"Hills upon hills,
Mountains on mountains rise,"

where a barrow does not exist or is not known to have existed. In passing along the old high road, for instance, over Middleton Moor by way of Arbor-Low,* Parcelly Hay, High Needham, Earl Sterndale, and Brier-Low, to Buxton, or along the high roads by way of Winster, Hartington or Newhaven, the practised eye has no difficulty in resting on the forms of grave-mounds on the summits of the different hills or mountains whose outlines stand out clear and distinct against the sky.

The situations chosen for the burial of the dead by the early inhabitants of Derbyshire were, in many instances, grand in the extreme. Formed on the tops of the highest hills, or on lower but equally imposing positions, the grave-mounds commanded a glorious prospect of hill and dale, wood and water, rock and meadow, of many miles in extent, on every side, stretching out as far as the eye could reach, while they themselves could be seen from afar off in every direction by the tribes who had raised them, while engaged either in hunting or in their other pursuits.

In Derbyshire the grave-mounds are called "Lows" or "Barrows;" *Low* being so very usual a term in the district that wherever met with, it may be taken as a sure indication of a barrow now existing or having once existed at the spot. As a proof of this, it will only be necessary to say that at about two hundred places in Derbyshire alone, and at about half that

* Of this stone circle, the next in importance to Stonehenge, an account will be given in a future number.

number on the neighbouring borders of the adjoining county, Staffordshire, which bear the affix of *Low*, barrows have already been opened, or are known to exist. For my present purpose, the names of Arbor-Low, Kens-Low, Ringham-Low, Blake-Low, Fox-Low, Gib-Low, Green-Low, Great-Low, Grind-Low, Cal-Low, Chelmorton-Low, Casking-Low, Larks-Low, Thirkel-Low, Ribden-Low, Har-Low, Bas-low, High-Low, Foo-Low, Lean-Low, Huck-Low, Borther-Low, Dow-Low, Totman's-Low, Staden-Low, and Stan-Low, will be quite sufficient to give as illustrative examples. To some of these I shall again have occasion to refer.

The grave-mounds of the district of which I am speaking may, naturally, be divided into the three great periods; the Celtic, the Romano-British, and the Anglo-Saxon. Of these by far the greatest number are Celtic, whilst the least number are Romano-British. It is my intention to divide my subject into these three periods, and, while speaking of the characteristics of each, to classify and describe the contents of the barrows and to point out, briefly, such circumstances of interment, and such evidences of customs, which they may present and which may appear to be of sufficient interest and importance for my purpose.

THE CELTIC PERIOD.

The barrows of the Celtic, or ancient British period vary in their form and size as much as they do in their modes of construction, and in their contents. Sometimes they are simply mounds of earth raised over the interment; sometimes heaps of stones piled up over the body; and sometimes again a combination of cist, and earth, and stone. Generally speaking, the mounds are circular, rising gradually and gently from the level of the ground towards the centre, but in some instances the rise is somewhat acute. Now and then they are oval in form. Where elliptical barrows occur (generally known as "long barrows") they are, I have reason to believe, not matters of original design, but of accident, through additional interments; and I much doubt the propriety of archæologists at the present day, continuing the very questionable nomenclature adopted by Sir R. C. Hoare and others. An examination of a very large number of barrows leads me to the opinion that the original form of all was circular, and that no deviation from that form, and no difference in section, can be taken as indicative of period or of race.

The Celtic barrows of Derbyshire contain interments both by inhumation and cremation, and the modes of interment vary very considerably. Where interment has been by inhumation,

the body is mostly found in a contracted position on its side, (more commonly the left than the right side); the knees drawn up near to the chest, and the heels to the thighs; the elbows near the knees and the hands in front of the face; the head inclining somewhat forward. This position, which, as I have said, is the most usual one, will be best understood by reference to the accompanying engraving, which shows an interment found in a barrow on Smerril Moor, opened by my much

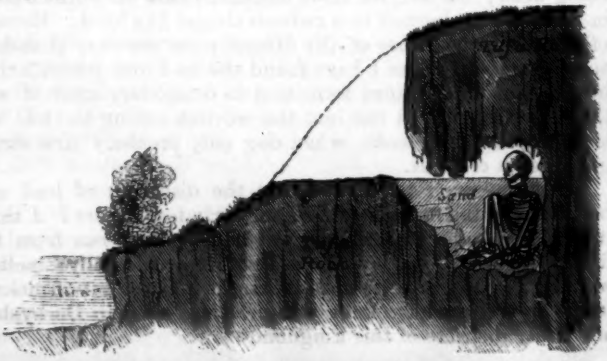
lamented friend the late Mr. Thomas Bateman. In this case, the body had been laid in an irregularly formed cavity on the surface of the natural rock, on a bed of clay, over which, as usual, the mound was formed of loose stones, and mould. Behind the skeleton, as will be seen in the engraving, was found a remarkably fine "drinking cup," along with other articles, about which I shall have occasion to speak.

Occasionally the body lies at full length, but this is quite the exception to the rule. In one or two instances in Derbyshire, as in Guernsey, the skeleton has been found in a contracted upright position in the stone cist of a barrow. This position will be seen in the annexed engraving which accurately represents the section of the barrow when the superincumbent earth and stones had been removed.

This barrow was situated at Parcelly Hay. The body had been placed in a small oval excavation in the solid rock, about

three feet in depth and the same in its longest dimension. This cist had been loosely covered with large flat stones over which the mound had been raised. Above this, which was the

primary interment of the barrow, another interment, with the body lying in the usual contracted position on its left side, had



been made. (Of this barrow an excellent account is given in "Crania Britannica.")

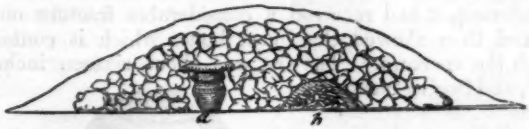
Another excellent example of this very unusual mode of interment was discovered by some tufa-getters, and examined by Mr. Bateman, in Monsal Dale, and is shown on the preceding engraving, which exhibits a section of the rock, etc.; and shows the position of the skeleton, and the manner in which the cavity containing the body had been filled up with the river sand. The body in this case as in the last, had been placed in the cavity in a sitting position, and must have been so placed from an opening in front. The cavity was ten or twelve feet above the bed of the river Wye, and above it were some five feet in thickness of solid tufa rock, while, from the face of the rock, the cavity was about twelve feet. The body may therefore be said to have been entombed in the middle of the solid rock. The roof of the cavity when found was beautifully covered with stalactites. The skeleton was that of a young person, and near it was found a flint and some other matters. The cavity was filled to part way up the skull with sand.

When the interment has been by CREMATION, the remains of the burnt bones, etc., have been collected together and placed either in a small heap, or in a cinerary urn, which is sometimes found in an upright position, its mouth covered with a flat stone, and at others inverted over a flat stone or on the natural surface of the rock. This position, with the mouth downwards, is, perhaps, the most usual of the two. The place where the burning of the body has taken place is generally tolerably close to the spot on which the urn rests, or on which the heap of burnt bones has been piled up. Wherever the burning has taken place there is evidence of an immense amount of heat being used; the soil, for some distance below the surface being in many places burned to a redness almost like brick. Remains of charcoal, the refuse of the funeral pyre, are very abundant, and in some instances I have found the lead ore, which occurs in veins in the limestone formation so completely smelted with the heat that it has run into the crevices among the soil and loose stones, and looks, when dug out, precisely like straggling roots of trees.

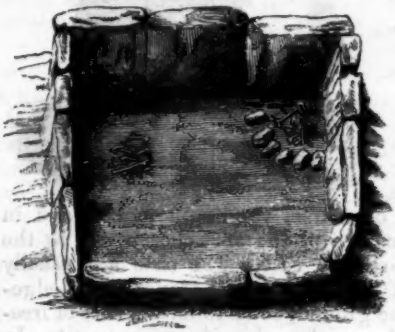
Is it too much to suppose that the discovery of lead may be traced to the funeral pyre of our early forefathers? I think it not improbable that, finding the liquid metal ran from the fire as the ore which lay about became accidentally smelted, would give the people their first insight into the art of making lead—an art which we know was practised early in Derbyshire and other districts of this kingdom.*

* Lead mines there are in Derbyshire worked at the present day which were worked, at all events, in the Romano-British period. Roman coins, fibulæ, and other remains are occasionally found in them.

To resume. The positions I have spoken of in which the cinerary urns and heaps of burnt bones have been usually found, will be best understood by the accompanying engravings. The first represents a section of a barrow in which, at



a, is shown a sepulchral urn in an upright position, capped with a flat stone; and at *b* a heap of burnt bones piled up in the usual fashion, and first covered with earth and then with the loose stones of which the whole barrow was composed.



The next engraving again, shows, within a cist, in a barrow on Baslow Moor called "Hob Hurst's House," two heaps of bones, the one simply collected together in a small heap, and the other guarded with a row of small sandstone "boulders," all of which had been subjected to fire.

The next illustration gives a section of the Flax Dale barrow at Middleton by Youlgreave, which shows the inverted position of the sepulchral urn. This barrow was formed on a plan commonly adopted by the ancient Britons, and will therefore serve as an example of mode of construction as well of the inverted position of the urn. A circle of large rough stones was laid on the surface of the ground, marking the extent of the proposed mound. Within this, the inter-

ments, whether in an urn or not, were placed, and the mound was then raised of stones to the required height, and afterwards covered to some thickness with earth, and thus the outer

circle of the barrow was considerably extended, as will be seen by the engraving.

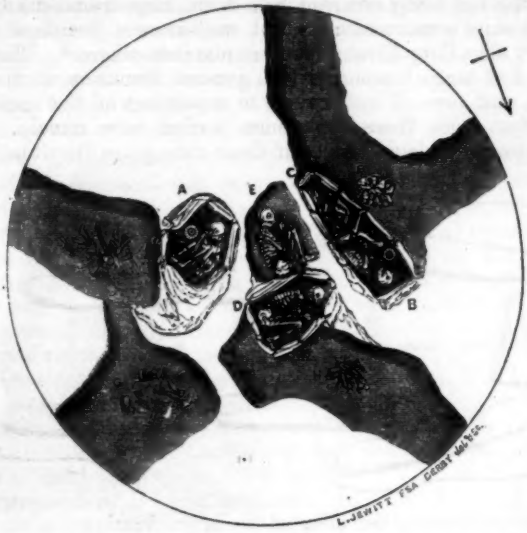
Another excellent example of the inverted position of the sepulchral urns is here given, from one of the cists in Rolly-Low, near Wardlow. I have chosen it because when found by Mr. Bateman, it had received a considerable fracture on one side, and thus showed the burnt bones which it contained, through the aperture.* The urn was about sixteen inches in height, and twelve inches in diameter, and was ornamented in the usual manner with indentations produced by a twisted thong. It was inverted over a deposit of calcined human bones, among which was a large red deer's horn, also calcined. The urn was so fragile, as to be broken to pieces on removal.

It is not unusual in the Derbyshire barrows for the interments to be made in stone cists, and these of course, vary both in size and in form, according to the nature of the spot chosen, and to the requirements of each particular case. The cists are usually formed of rough slabs of limestone or grit-stone, set up edgeways on the surface of the ground, so as to form a sort of irregular-square, rhomboidal, or other shaped compartment. In this the interment, whether of the body itself or of the urn containing the calcined bones, has been made, and then the cist has been covered with one or more flat stones, over which the cairn of stones has been raised. Some barrows contain several such cists, in each of which a single, or in some instances a double, interment has been made. An excellent example of this is afforded by the accompanying engraving, which shows the ground plan of a barrow opened by myself, and my friend Mr. Lucas,† on Hitter Hill. The shaded portions of the plan,

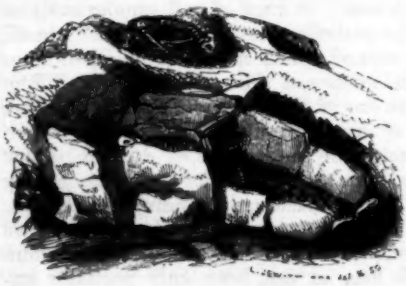
* Although I am describing the position in which the urns have been placed, it must not for a moment be supposed that they are often found in a perfect state, or in the position in which they have originally been placed. On the contrary, the urns are usually very much crushed, and not unfrequently from pressure of the superincumbent mass of stones and earth, are found on their sides, and crushed flat.

† For an illustrated account of this barrow see "The Reliquary, Quarterly Archæological Journal and Review," vol iii. p. 159, et. seq., from which these engravings are borrowed; and "Crania Britannica."

show the extent of the openings we made in the barrow, and A, B, C, and D, show the stone cists containing interments of which



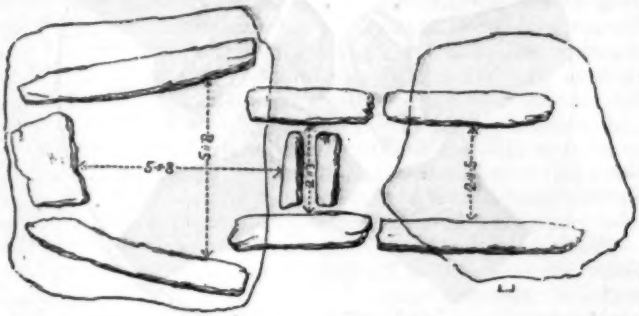
I have been speaking. Two of these cists (B and C) are also shown on the annexed vignette. With the skeleton in cist



B, here shown, a beautiful and highly ornamental "food vessel" was found, to which I shall have occasion later on to refer. Occasionally, when the natural surface of the ground was not sufficiently even or solid for the interment to be as conveniently made as might be wished, a flooring of rough slabs of stone was laid for the body to rest upon.

Chambered tumuli of somewhat similar construction to the one at New Grange, in Ireland, exist in Derbyshire, and are of the most interesting character. The principal of these megalithic structures remaining, are the one at Minning-Low, and the one known as the "Five Wells," near Taddington.

The first of these contains in the centre, and in four places within the area of the circle, large cists, or, as they now appear from the soil being removed from them, large cromlechs exactly of the same construction as that well-known Druidical structure, "Kits-Coty-House," and numberless others.* They are formed of large limestones (the general formation of the district), and have all had covers, or cap-stones of the same, but only two with these cap-stones perfect now remain. The accompanying plan of some of these cists gives the situation of



the stones forming the sides of the large chamber; of the passage leading to it; of the slabs which closed its entrance; and of the covers or cap-stones. The chamber is rather more than five feet in height, and the largest cap-stone about seven feet square and of great thickness. A kind of wall similar to those which have been found to encircle some of the Etruscan tumuli, forms the circle of this mound, which rises to a height of more than fifteen feet from the surface of the ground. The "Five Wells" tumulus contains one of the most perfect examples now remaining of this kind of arrangement. "It consists of two vaults or chambers, situated in the centre of a cairn, about thirty yards in diameter, each approached by a separate gallery or avenue, formed by large limestones standing edgeways, extending through the tumulus, respectively in a south-east and north-west direction." Another five-chambered tumulus is Ringham-Low, which has, as yet, been only partially examined.

In some instances, the barrows are formed almost wholly of earth, and where they contain examples of urn burial, or of cremation without urns, the indications are frequently very striking. It not unfrequently happens that the spot where the

* As a rule the structures known as cromlechs, Druidical altars, etc., are these large sepulchral cists from which the earth forming the mound has at some time been removed.

funeral pyre has been lit can very clearly be perceived, and, as I have said before, in these instances the ground beneath is generally burned to some considerable depth. Where it was intended that the remains should be collected together, and placed in an urn for interment, I apprehend, from careful examination, that the urn being formed of clay—most probably, judging from the delicacy of touch, and from the impress of fingers which occasionally remains, by the females of the tribes—and ornamented according to the taste of the manipulator, was placed in the funeral fire and there baked, while the body of the deceased was being consumed. The remains of the calcined bones, the flints, etc., were then "scraped" up together and placed in the urn; over which the mound was next raised. When it was not intended to use an urn, then the remains were collected together, piled up in a small heap, and covered to some little thickness with earth (and occasionally small stones). Another fire was then lit on the top of this small mound, which had the effect of baking the earth, and enclosing the remains of calcined bones, etc., in a kind of crust resembling in colour and hardness, a partly-baked brick.

Having now spoken of the principles of construction of the Celtic grave-mounds of Derbyshire, and described the various modes of interment which they exhibit, I shall in my next paper proceed to describe the pottery and the objects of flint, bone, and stone, which they contain.

(To be continued.)

THE NOVEMBER SHOOTING STARS.

BY RICHARD A. PROCTOR, B.A., F.R.A.S.

(With a Plate.)

It is probable that there will be this year an exhibition of the November shooting stars, though it is uncertain whether the phenomenon will be so well seen in Europe as it was last year. As a *display* the shower is not likely to be so splendid as it was in 1866, since on November 14th of the present year, the moon will be nearly full. However, there can be no doubt that the November meteors will be looked for again with great interest, since the discoveries which have been made respecting the orbit in which they move, have presented them to us in a new aspect.

When the shower of November last was under discussion, it was very noteworthy how indistinct were the views of many persons—I may even say of many *astronomers*—respecting the relations of the earth's globe, as it travelled onwards rotating in its orbit, to the meteor stream which it encountered. I do not here refer to the doubt and obscurity under which the question of the path actually pursued by the meteors rested at that time. The investigation of this question was one of extreme difficulty, one which taxed—and not lightly—the powers of the highest modes of mathematical analysis. But many appeared to find considerable difficulty, or failed altogether in forming an estimate of the circumstances under which the meteors became visible to us. The existence of a "radiant point" from which all the shooting stars appeared to travel, in whatever part of the sky they made their appearance, was a phenomenon which — although in reality it inferred the solution of the problem of the meteors' origin—yet presented difficulties to many observers. The questions that were asked and the suggestions that were offered on this and kindred points, were many and amusing. One observer, noticing the comparative absence of meteors from the immediate neighbourhood of the "radiant point," suggested in explanation of the peculiarity, that the earth was passing through a sort of tunnel traversing a bed of meteors; thus in the path along which the earth travelled, there were no meteors or few—previous passages along the same track having cleared the way—but many meteors grazed the earth's atmosphere, the bore of the tunnel only allowing the solid globe of the earth to pass freely. And, indeed, the supposition that shooting stars are only seen when *grazing* our atmosphere has been commonly entertained and expressed even by astronomers of eminence. Sir

John Herschel, for example, speaks of meteors as "bodies extraneous to our planet, which only becomes visible when in the act of grazing our atmosphere." The idea, however, is wholly erroneous, as we shall presently see. Another remarkable question which was asked soon after the occurrence of the November shower, served still more clearly to exhibit the indistinctness of the views commonly held; meteors having been seen at Cape Town at the same hour (actual time) as in England, it was asked how the same meteors could be seen in both places, unless they had travelled as satellites round the earth? An eminent chemist, who has lately published a work on meteors, speaks of the received opinion of the cosmical origin of meteors, as, after all, merely conjectural, and he evidently leans towards the theory that they are satellites of the earth. Lastly, in Guillemin's "Heavens," a view is expressed (and illustrated by an elaborate figure), which is wholly inconsistent with observed appearances. I refer to the notion that a single stream of bodies could give rise to both the November and August showers.

It is evident, therefore, that there is room for a careful examination of the actual state of things during the occurrence of the November shower. By considering the position of England on the rotating earth, during the time of the display, we shall be able to form clear views on this point.

I must first, however, mention briefly the true meaning of the existence of a "radiant point." Once this phenomenon is established, *all doubt whatever* respecting the cosmical origin of a shooting star shower disappears. It is not true that the theory of a cosmical origin is now a conjectural one; it is established on a thoroughly firm basis. The phenomenon of a radiant point proves in fact *this*, that the paths in which the meteors intersect our atmosphere, are all parallel *in space* throughout the time that the shower is visible. Now the display lasting several hours, during which the earth moves through a large angle round her axis of rotation, it is quite clear that the display cannot have a terrestrial origin, since if it had, the direction of the shooting stars might be *expected* to change *correspondingly*, and *would certainly* not change after so artificial a manner that for several places at once the effects of the earth's rotation would be *exactly compensated*. An equatorial telescope, for instance, is made by clockwork always to point to the same star, but we know that no telescope fixed *at random* and moved at a *random rate* would do so. Just, therefore, as a person seeing the same star for a considerable time through the tube of a telescope, knows certainly that he is looking through an equatorial rendered artificially independent of the earth's rotation—so, seeing shooting stars moving always from

a fixed point among the stars, we know for certain that the direction of their motion is independent of the earth's rotation, and therefore—there being no possibility of an artificial arrangement corresponding to that of the equatorial—that the shooting stars come from external space. The notion of a lunar origin, and the satellite theory of meteors are similarly overthrown, though indeed, at the present day, no competent person entertains either of these views, which are for other reasons, wholly untenable. When the occurrence of a "radiant point" is coupled with "annual periodicity and independence of geographical position, referring us at once to the place occupied by the earth in its annual orbit," the most sceptical (or, in this case, we must say those least able to appreciate the mathematical demonstration of the meaning of a radiant point), must be led "directly to the conclusion that the earth is liable to encounters or concurrences with meteor streams in their progress of circulation round the sun."

It must be mentioned that the earth's motions have their effects upon the apparent motion of bodies moving in space. The motion of rotation, however, may be neglected in comparison with the motion of revolution and the proper motion of meteoric bodies. Travelling in space, under the sun's attraction, they cannot, at the moment of encountering the earth, be moving with a less velocity than that due to a body moving circularly round the sun at the earth's distance (a rate very slightly less than the earth's) and they may have a velocity nearly half as great again as this. Between these values their velocity necessarily lies. Further, their velocity, relatively to the earth, must lie somewhere in value between the sum and difference of their actual velocity and the earth's, or between zero and about forty-five miles per hour; the first value giving the extreme case of meteors travelling in the same direction, and at the same rate as the earth; the second giving the case of meteors travelling in a parabolic orbit, and encountering the earth *directly*, just when they are *in perihelion*.

I have mentioned these limits and considered the nature of meteors' motion relatively to our earth, because it is on this relative motion that the position of the "radiant point" depends. If we suppose the earth reduced to rest, and her motion, *reversed*, added to the motion of the meteoric stream, we get the same *relative* motion, and the same *radiant point* as under the actual circumstances of the case. For clearness of explanation let us suppose this to happen, and that on the night of November 13—14 the earth's motion of revolution is non-existent (her motion of rotation continuing, however), and that the meteors are sweeping towards her from their radiant point (*i.e.* at a rate and in a direction resulting from the

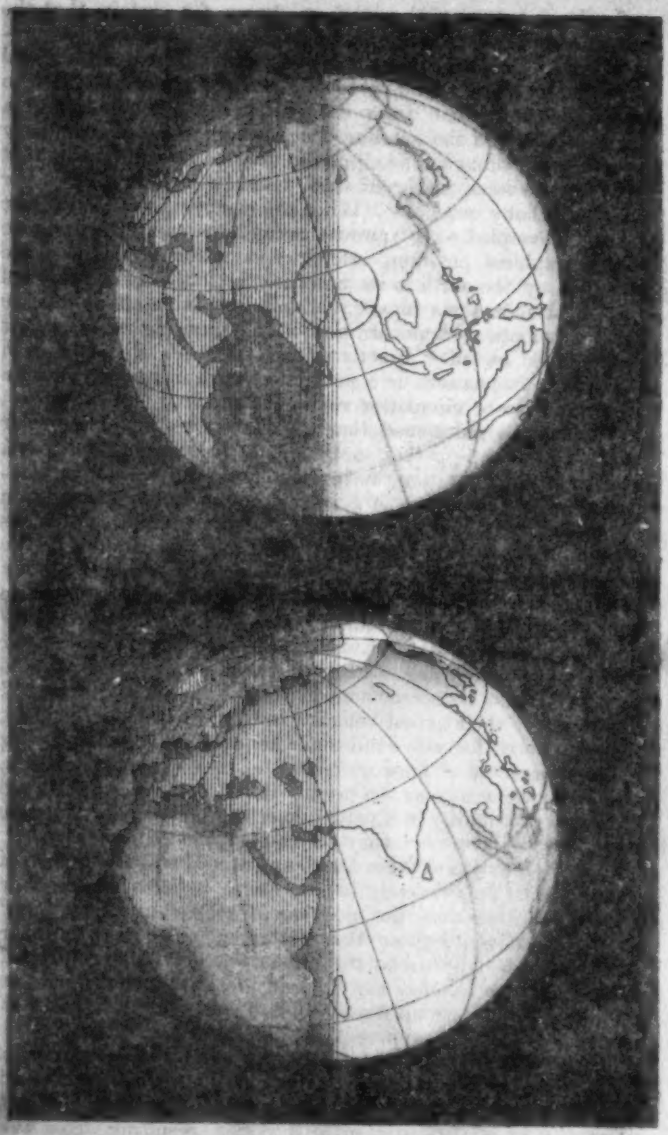


Fig. 1

Fig. 2

The Earth: viewed from the Radiant-Point of the November Meteors

1. $12^h\ 15^m$ G.M.T. 2. $2^h\ 15^m$ G.M.T.

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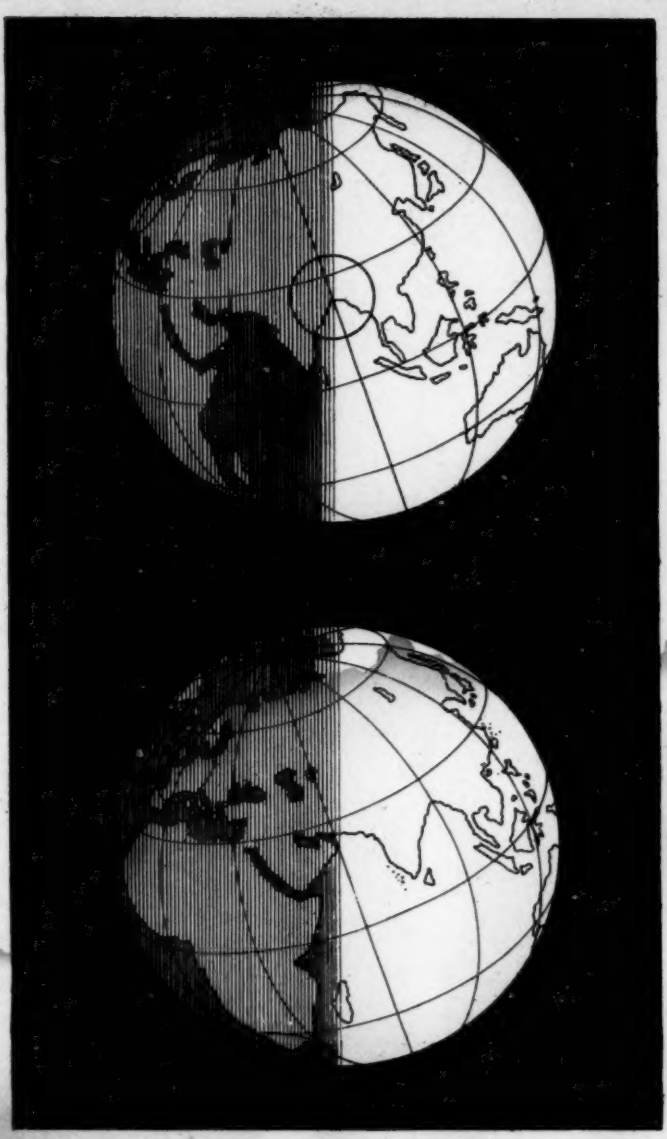


Fig.1

Fig. 2

The Earth: viewed from the Radiant-Point of the November Meteors

1. $12^h\ 15^m$ G.M.T. 2. $2^h\ 15^m$ G.M.T.

combination of their own actual motion, and the earth's motion applied in a reversed direction).

These suppositions being made, we can have no difficulty in selecting a suitable point of space from which in imagination to view our earth. The "radiant point" is clearly the proper point to select. If the reader, therefore, will suppose himself somewhere in space, between ϵ and μ Leonis, and armed with sufficient optical power, he will be prepared for the examination of the illustrative Figs. 1 and 2. In these the earth is supposed to be viewed from such a direction; in Fig. 1, at about a quarter past twelve, and in Fig. 2, at about a quarter past two, Greenwich solar time, on November 14th, in any year. The shaded half of each hemisphere is the portion turned from the sun, the apparent boundary of this portion being a straight line, because the radiant point (as respects its *longitude*) is situated very nearly in the direction towards which the earth is moving at the time. But since the radiant (as respects *latitude*) was raised some 10° to the north of the ecliptic, the north pole of the earth is brought more into view than it would be to an observer placed at a point towards which the earth is actually moving at the time. In fact, the presentation of the earth towards the radiant point happens to be almost exactly the same (as to inclination of the polar axis) as the presentation of the earth towards the sun at the time of summer solstice. Without entering further into these points, it will suffice to say that Figs. 1 and 2 are the results of mathematical calculation and careful construction—not imaginary figures set down partly at random, as is too often the case with illustrations of this sort. I am particular to mention this, because when it is known that an astronomical picture represents actual facts, as closely as possible, the student will undertake the study of the picture with some hope of information and instruction, whereas the study of illustrations (so-called) not carefully constructed—and nine out of ten figures in our works on popular astronomy fall under this category—is often worse than unprofitable.

Around London and Calcutta in Map 1, and around London and Cape Town in Map 2, oval and circular spaces are indicated. It is necessary to explain the meaning of these. Assuming the depth of our atmosphere to be about seventy miles—or, at any rate, that meteors are not commonly visible at greater heights—it is easily shown that the segment of atmosphere cut off by a plane touching the earth at any point, has a circular base about 1,500 miles in diameter. Thus neglecting the effects of refraction which would slightly increase the dimensions of the segment, we have this result, that no meteor can be seen from any point of the earth's surface further than 750 miles from the point over which such

meteor is vertical. We have very strong evidence, showing that 70 miles is about the height at which meteors appear, the evidence of meteors appearing at a greater height being very doubtful. Hence, when a meteor is seen low down towards the horizon, it may be confidently assumed that the point over which this meteor is vertical lies within 750 miles of the place of observation. Now the ovals and circle in Maps 1 and 2 mark the limits of the space over some point of which a meteor must be vertical to be seen from the centre of the space. For instance, a meteor appearing at a point vertical over Madrid, or Turin, or Berlin, or Stockholm, might *just* be visible from London, appearing just above the horizon; but a meteor vertical over Gibraltar, or Rome, or St. Petersburg, would not be visible in England.

Now, if we consider Map 1, we shall see that about two hours before the time indicated by that map (a quarter past twelve at night), London is just becoming visible on the edge of the earth's disk; but the edge of the oval space round London comes into view more than an hour earlier—that is, at about nine o'clock. This is the earliest hour at which a member of the November system can by any possibility be seen in London. Meteors seen at this hour would be momentarily visible in the eastern horizon, moving upwards. When London comes to the border of the visible hemisphere, meteors may be looked for over the whole space between the eastern horizon (that is from south, through east to north) and the zenith, travelling (more or less) upwards unless they appeared nearly towards the north or south, when their motion would be horizontal. When the whole of the London oval space is in view, meteors may be looked for over the whole heavens. A little consideration will show that at and after this time, conspicuous meteors will be seen more plentifully over the western half of the heavens. If the mere number of meteors indeed, were alone considered, the contrary would be the case. But the paths of meteors being from a point east of London (it is clear that both in Map 1 and in Map 2, we are looking at London from the east), they would have in general an apparently westward motion, and all those having long visible tracks would be towards the west.

It is also evident from Figs. 1 and 2, that meteors increase in number (*cæteris paribus*) as England, through the earth's rotation, approaches the centre of the disk visible from the radiant point, or—which amounts to the same thing—as the radiant point rises above the horizon. It is clear, for instance, that the oval space round England in Fig. 2, is greater than the oval in Fig. 1; and that at an hour later than that indicated in Fig. 2, the oval is yet greater. The oval round England is

greatest at about a quarter past six, when the meridian of London is a diameter of the disk. The effects due to this cause of variation ought to be considered in estimating the actual changes in the richness of the shooting star-stream as the earth traverses different strata. For instance, the increase which actually occurred after midnight, last November, was partly due to this cause, while the diminution which took place subsequently to 1h. 30m. or 1h. 45m., was partly checked by this cause.

Let us stay for a moment to compare with the effects just considered, those occurring in other latitudes. It is clear from Figs. 1 and 2, that countries in northern latitudes are more favourably situated than countries in southern latitudes, as respects their chance of seeing the November star-shower. Thus, if we consider the short part of the arc traversed by Cape Town, which lies within the darkened part of the disk, it is clear that the *á priori* probability that observers there will see the phenomenon is small. The hour at which Cape Town reaches the diametral meridian being about 6h. 15m., Cape time, it is clear that the moment at which Cape Town enters on the part of the disk visible from the radiant point, is about 2h. 15m. The oval round Cape Town begins to enter this part of the disk rather more than one hour earlier. Thus, unless the phenomenon occurs between about one o'clock and day-break (it will be seen that Cape Town enters the enlightened half disk, or, in other words, *the sun rises* there soon after five), it will not be seen at all at Cape Town; and that it should be well seen, it is necessary that the epoch of maximum richness should occur between 1h. 30m. and 3h. 30m. Cape time. It happened last November, that the shower reached its maximum at 2h. A.M., Cape time, and was, therefore, well seen there.*

In tropical regions north of the equator, which enter on the hemisphere turned towards the radiant during the continuance of the shower, the display is likely to be grander than elsewhere, since the circular space around any point in such regions would be seen as an oval of much less eccentricity than that round places in high latitudes, during a part at

* For the same reason that meteors are more commonly seen in northern latitudes from July to December, they are more commonly seen in southern latitudes from January to June. An examination of Figs. 1 and 2 will illustrate the cause of this peculiarity, viz.:—the presentation of the northern and southern poles respectively towards the direction of the earth's motion. It is worthy of notice that Mr. Maclear records the observation of several meteors last November, before the hour at which Cape Town (or the space included within the oval in Fig. 2) entered on the hemisphere turned towards the radiant; or, in other words, before the radiant rose above the horizon: but none of these belong to the November system, as is evidenced by the direction of their motion.

least, of their passage across the darkened part of the disk. At Calcutta, for instance, the boundary of visibility is appreciably circular (as shown in Fig. 1) a short time before sunrise. At this hour, last November, the shower had not reached its full splendour, and therefore, the richer part of the display was not seen in Calcutta. In Nubia, Egypt, Asia Minor, and Greece, the shower was more favourably seen. Mr. Schmidt, for instance, reported a very rich display at Athens, reaching its maximum at 2h. 15m. local time, or about 12h. 45m. Greenwich time; very nearly the hour illustrated in Fig. 1. The display in India (at Kishnagur, fifty miles from Calcutta) began before four o'clock, and continued till daylight. At 4h. A.M., Calcutta mean time, which corresponds to 10 P.M., Greenwich time, London had not yet reached a position for a favourable view of the display.

It will be seen from Figs. 1 and 2, that during nearly the whole time that the display continued, last year, in England, every visible shooting star was travelling towards the earth's surface, *not* grazing the atmosphere. Thus no shooting star which fell within the oval line marked round England in Fig. 1, or in Fig. 2, could have failed to reach the earth's surface, unless dissipated in the upper regions of air. And, indeed, independently of the consideration of the November shower, and its radiant, it is quite clear that of meteors which pass into an atmosphere, by far the larger number travel in a line which produced meets the earth's solid surface. For, in whatever direction a meteor stream is travelling, the earth, seen from the radiant point of the stream, must present an appearance corresponding to that illustrated in Figs. 1 and 2. The pole may be more or less bowed towards, or from, the direction in which the meteors are travelling (relatively) towards the earth, and other countries than those presented in the figures, may be turned towards the meteor-flight; but a circular disk, apparently fringed with a comparatively narrow border of atmosphere, must in every case be presented towards the meteor-stream. Only those meteors which impinge on this fringe, a circular ring 70 miles wide,* can possibly free themselves by passing through (or grazing) the atmospheric envelope. All those meteors which are making for the apparent disk of the solid earth, a circle, nearly 4,000 miles in radius, must inevitably reach the earth, either in a solid form or in the form of meteoric dust, after being dissipated in their passage through the upper atmospheric layers. Assuming that every meteor making for the fringe escapes, which is,

* Of course, not in reality such a ring, but apparently so viewed from the radiant point of the meteor-flight; and intercepting the same proportion of meteors as if actually so.

however, utterly improbable, it may easily be calculated that for every meteor grazing our atmosphere (at a height not exceeding 70 miles), twenty-eight travel directly towards the earth's surface. But the proportion must in reality be very much greater, since our supposition implies the possibility of a meteor travelling through the air in a direction actually tangent to the earth's surface, or passing through about 1,450 miles of air, including the densest strata. Since meteors seldom penetrate to a vertical depth of more than twenty or thirty miles, without dissolution, it is very unlikely that meteors travelling parallel to the horizon should penetrate to a vertical depth even of ten or fifteen miles—since, to do so, their actual path through the air would be many times longer. Assuming that meteors could escape after penetrating in this manner to a depth of twenty miles, we should have, for every meteor so escaping, almost exactly one hundred whose substance, whole or dissolved, would reach the earth. Even escaping meteors would never again appear as members of the November shower, since their orbit, after grazing contact of the kind supposed, would be very different (owing chiefly to their loss of velocity) from that they originally pursued.

In the fact that such multitudes of meteors have, during so many and such brilliant displays of November showers as have been recorded, been stolen by the earth from the stream to which they belonged, serves to afford some conception of the immense number of meteors forming the November stream. Yet clearer views will be formed on this point if we consider the evidence we have respecting the length, breadth, and thickness of the cluster, during the passage through which the display is visible. I have not space to dwell here on Adams' investigation of the meteoric orbit. But it is necessary to point out that we must now greatly increase our estimate of the length of the cluster causing the November showers. The recurrence of displays during two or three consecutive years was simply accounted for on the theory of a nearly circular orbit, without assuming for the cluster a length of more than a few millions of miles. Now that we know that the meteor-flight travels in an orbit of great eccentricity, and with a period of 33¼ years, we know that the portion passed through by the earth in one year is several hundreds of millions of miles away, when the earth next passes through the meteor orbit. Hence the recurrence of displays leads us to estimate the length of the cluster by hundreds of millions of miles, instead of by mere millions.

Next, for the breadth of the stream. On this point we have no exact information. It is sometimes assumed that the fact that the display may be seen in one hemisphere, while in

another it is not seen (as last year, for instance, in America), points to a limit of breadth. But this is not the case. If we consider Figs. 1 and 2 we shall see that America was on the sheltered side of the earth during the whole time of the display. When America had come to the side turned towards the radiant, the earth's globe had, in all probability, passed through the meteor-stream. So that the limits of the *thickness*, and not of the *breadth* of the stream, were indicated by the non-visibility of the meteors in America. Before the display had begun in England, the meteors, were seen from Kishnagur, fifty miles north of Calcutta, and they continued visible until the time of sunrise there. This would assign a breadth of *not less* than 4,000 miles to the stream. But as, throughout the continuance of the display, the earth was crossing the breadth of the stream at the rate of about 1,000 miles an hour, we can assert positively that the breadth of the stream exceeded 6,000 miles. In reality, however, a very much greater breadth may be assigned, with great probability, to the meteor-stream. For if we consider the nature of the stream and the manner in which it has been probably generated in the track of Comet I., 1866, we shall see the great probability that its breadth exceeds its thickness. For the causes tending to make meteors leave the mean plane of motion, are much less efficient than those tending to distribute the meteors over that plane. Now the earth, during the time of the display, was crossing the *thickness* of the meteor-stream at the rate of about 18,000 miles an hour. Therefore, since the display lasted at least six hours (counting from the time of its being observed in India, when England was, as yet, on the earth's sheltered side), we cannot assign to the stream a less thickness than 100,000 miles. The breadth is probably at least ten times as great.

It may be assumed as certain, that it is the passage of the earth through the *thickness* of the meteor-stream which limits the duration of the display.

I shall conclude by quoting two observations, showing that the fine powder in which meteors reach the earth may be detected. Dr. Reichenbach collected dust from the top of a high mountain, which had never been touched by spade or pick-axe; and on analysis he found this dust to consist of almost identically the same elements as those of which meteoric-stones are composed—nickel, cobalt, iron, and phosphorus. Again, Dr. Phipson notes, that "when a glass, covered with pure glycerine, is exposed to a strong wind, late in November, it receives a certain number of *black angular particles*," which "can be dissolved in strong hydrochloric acid, and produce yellow chloride of *iron* upon the glass-plate." I quote these

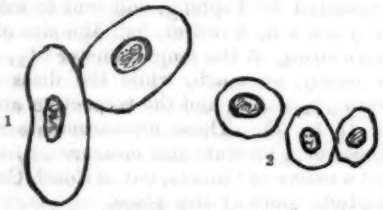
observations on account of the interest attaching to them; *not* as evidence to show that the majority of shooting stars never pass out of the earth's atmosphere. Such evidence is not required—the fact being mathematically demonstrable.

THE LARGEST BLOOD DISCS KNOWN—SINGULAR CAPTURE OF A CANADIAN REPTILE, MENOBRANCHUS LATERALIS.

A WEEK or two since we received by post from Canada two glass slides containing numerous blood discs of large size, which at once reminded us of those of the Lepidosiren, but on comparison were found much bigger. A few days later came the following interesting letter from a Canadian subscriber, who has not favoured us with his name, but to whom we beg to express our thanks. The *Menobranchus* of which he speaks belongs to an interesting group, the Ampibia, possessing permanent gills, and comprehending the Proteus, Siren, etc.

The letter runs as follows:—

"I take the liberty of sending you two slips of glass, upon which you will find specimens of the blood discs of *Menobranchus lateralis*, one of the salamander family, inhabiting Lake



BLOOD DISCS.—1. *Menobranchus lateralis.* 2. Siren. 3. Man. × 300.

Ontario. It is remarkable for being furnished with both lungs and gills, so as to be able to live either on land or in the water. It is seen occasionally ashore, but usually prefers the water. It much resembles a similar animal found in the Lake of Mexico (*Axolotlus pisciformis*), but differs from that species in the number of its toes, of which it has four on each foot, and in having no toe-nails. There is a good likeness of this reptile in the "Encyclopædia Britannica," vol. xix., 8th edition; but it is in reality considerably darker than the picture. They are not often seen here. I have known only five or six taken alive in thirty years. The specimen of which I send you the blood discs was taken by a water-snake, which brought it

ashore, and had it half swallowed, when in his turn the snake was captured by a spectator. When I saw them the snake (about four feet long) had disgorged his prey, which was covered with blood and dust, and apparently dead. On being placed in a vessel of water, the lizard immediately revived, and then appeared to be furnished with three branchial tufts on each side of his head, which were dusky on the upper side, but the fine filaments with which they were thickly tufted were of a dark red colour. They pulsated with a vigorous stroke about fifty times each minute, but would occasionally cease awhile when the animal was disturbed. Every minute or two he raised his head above the water, and opening a pretty wide mouth, took a gulp of air, which he afterwards expelled from the gills when under water. He was about thirteen and a half inches long and two broad, and was the largest I have seen of this kind.

"The morning after his capture it became apparent that the wounds inflicted by the snake would soon cause his death. The branchial motion had wholly ceased, and the reptile made a respiration of air only occasionally. When he appeared dead I made a small opening in his breast, and got some of his blood, which I hope that you will be pleased to have an opportunity of examining. The blood discs are of a very great size, so as to be visible to the naked eye. I have a slide of the discs of the Siren mounted by Topping, and sent to me as the largest known. They are not, however, half the size of those which I send you, measuring on the long diameter $\frac{1}{75}$, and on the short diameter nearly as much, while the discs of the *Menobranchus* measure $\frac{1}{34}$ × $\frac{1}{77}$, and the respective areas are in the proportion of 12 to 25. These measurements refer to the largest discs; those of a medium size measure $\frac{1}{44}$ × $\frac{1}{75}$.

"The Siren is not a native of Canada, but of South Carolina, twelve degrees of latitude south of this place.

"A Canadian Subscriber.

"Canada, 26*th August*, 1867."

MAN AND THE PLEISTOCENE MAMMALS OF GREAT BRITAIN.*

(Read at the Congrès Paléoethnologique.)

BY W. BOYD DAWKINS, M.A., F.R.S., MEMB. CORRESP.

THE remains of man have been found in various parts of Great Britain, associated with the remains of many of the post-glacial group of mammals, both in bone caverns and in river deposits. The implements found in the latter are precisely of the same character as those from the banks of the Somme, while, on the other hand, those in the caverns are smaller, and approach nearer to those found in the cave of Moustier than to any others. We will first examine the mammals proved to have coexisted with man during the time that ancient gravel and loam beds were being swept down by rivers that now flow at a lower level.

So far back as the year 1715,† a spear-head of flint was discovered, along with the remains of a mammoth, in the gravel of the Thames, near Gray's Inn Lane, in London, and is preserved in the British Museum. No particular notice was taken of this discovery until the year 1860. At the end of the last century, implements of a similar kind were found at Hoxne, in Suffolk,‡ and from that time down to the present numerous traces of man have been found in the same layer, along with the remains of mammoth, deer, and horse. Until, however, the discoveries of M. Boucher de Perthes called the attention of English savants to the existence of man in the post-glacial epoch, no notice was taken of the earliest known implements that man left behind him in the gravel. In the year 1861,§ Mr. Wyatt found, along with the remains of man, in the gravels of Bedford, the cave bear, bison, stag, reindeer, *Elephas antiquus*, hippopotamus major, and tichorhine rhinoceros. Among the fluviatile shells was a fresh-water mussel, extinct now in Britain, *Unio Batavus*, but which still lives in the Oise. The remains found by Dr. Blackmore at Salisbury, and described by Mr. Evans in his paper on flint implements in 1864,‖ were not derived from the same bed as the implements, but from one of a different character occurring at a lower level. They cannot, therefore, be cited as proving the coexistence of man with the extinct mammalia in Wiltshire.

* The French title of this paper was, "Sur les Mammifères Pleistocènes Trouvés avec L'Homme dans la Grande-Bretagne."

† "Archæologia," 1860-2. ‡ "Archæologia," 1800.

§ "Quart. Geol. Journ.," vols. xix. xx. ‖ Quart. Geol. Journ.," vol. xx.

These three localities are the only places in Britain where implements of man have been found associated with the extinct mammalia in post-glacial river deposits.

We come now to the evidence afforded by the caverns, which proves how essentially man formed one of the group of mammals existing in post-glacial times. In 1832, the Rev. Mr. McEnery began his excavation of Kent's Hole, near Torquay, Devonshire, and discovered numerous flakes of flint and spear-heads of the small flattened type found in the cave of Moustier. There were also roughly-chipped thin oval fragments of flints, of the type commonly called sling-stones. They were underneath the stalagmite, and associated with the remains of the following animals:—the cave lion, the sabre-toothed lion, the cave hyæna, wolf, fox, ermine, badger, cave bear, brown bear, otter, urus, Irish elk, stag, reindeer, mammoth, wild boar, *Hippopotamus major*, *Rhinoceros tichorhinus*, tailless hare, water-rat, *Arvicola pratensis*, *Arvicola agrestis*, hare, and rabbit. The occurrence of the great sabre-toothed lion in this deposit is so remarkable, that Dr. Falconer could not bring himself to believe that this Pliocene animal had really been found in the cavern, and he supposed it to have been mixed up, by some accident, with the remains from Kent's Hole, in Mr. McEnery's collection. That, however, the three canines upon which the determination of this mammal has been made were actually found in Kent's Hole, is proved by McEnery's manuscript, as well as by the condition of their matrix. He describes them, with other animals, from a portion of the cavern that he calls the Wolf's Passage, found underneath the stalagmite, with thousands of teeth of hyæna, horse, and rodents. Unfortunately, the account of the exploration of this cavern was not published until 1859,* and consequently the idea of the presence of the works of man with the remains of Pleistocene mammals, under circumstances which would prove that he lived in Pleistocene times, was not brought home to the minds of English savants until nearly thirty years after the discovery. In 1840,† however, Mr. Goodwin Austin put on record that he had obtained from the same cavern the works of man from undisturbed earth under stalagmite, mingled with the remains of extinct mammals. Public attention was not directed to the occurrence of flint implements in caverns until 1858, when the Royal Society, stimulated by the fruits of the

* "Cavern Researches," by the Rev. J. MacEnery, edit. E. Vivian, 8vo, 1859, p. 32:—"To enumerate the amount of fossils collected from this spot (Wolf's Passage) would be to give the inventory of half my collection, comprising all the genera and their species, including *cultridens* (Machairodus). The jaws of the elk, horse, and hyæna were taken out whole. The teeth of the two last were gathered in thousands, and in the midst of all were myriads of Rodentia."

† "Trans. Geol. Soc.," Ser. II., vol. vi., p. 433.

labours of M. Boucher de Perthes, undertook the exploration of the cave of Brixham, also near Torquay, Devonshire, Dr. Falconer, F.R.S., and Mr. Prestwich, F.R.S., being on the exploration committee. Their labours resulted in the discovery of flint flakes associated with the remains of the following animals, which have been determined by Mr. Busk:—cave lion, cave hyæna, fox, wolf, cave bear, brown bear, *Ursus priscus*, stag, roe-deer, reindeer, mammoth, horse, woolly rhinoceros, tailless hare, and teeth of arvicolæ. Mr. Busk has lately proved that the *Ursus priscus* of Goldfuss, quoted by Schmerling, from the caverns of Liege, is identical with the grizzly bear of the Rocky Mountains (*Ursus ferox*); so that we have another mammal to be added to the American group of animals that lived in France, Germany, and Britain with man.

Dr. Falconer and Col. Word, about the year 1858,* explored the caverns of Gower, in South Wales. They discovered vast quantities of flint flakes associated with the remains of the cave lion, cave hyena, fox, badger, cave bear, brown bear, grizzly bear, bison, Irish elk, stag, reindeer (*Cervus Guettardi* and *Cervus Bucklandi*), *Rhinoceros tichorinus* and *Rh. leptorhinus* of Owen (*Rh. hemitœchus*, Falc.). The association of these two latter animals in the same undisturbed earth proves that they cannot be considered as characteristic of two different geological epochs. In the year 1859,† I, together with Mr. Williamson, had the good fortune to explore a cavern at Wootrey, a village near Wells, in Somersetshire, that afforded, among vast stores of the remains of mammals, abundant traces of the presence of man. The cave opened on a ravine side; and at the time we began our excavations it was completely blocked up with earth. Lying on the floor, in the large chamber at the entrance, which was about eight feet high, about thirty feet wide, and very well lighted, were the remains of the fires and the feast of some ancient tribe. Among the calcined bones was one of rhinoceros, which, from its dark, carbonized character, must have been burnt while containing gelatine. In three distinct groups we found the implements that had been left behind, consisting of flint flakes, lance-heads of the type found at Moustier, sling-stones, and various fragments of flint that had been used for cutting. The presence of several flint cores proves that the manufacture of flakes had been carried on in the cave. There were also two arrow-heads found, without barbs; the one of chert, and the other of bone; the two lower angles of the latter being bevelled off. Unfortunately, both these were lost before they were engraved. There was also an implement of pyramidal

* "Quart. Geol. Journ.," 1860, vol. xvi., p. 489.

† "Quart. Geol. Journ.," 1862, vol. xviii. p. 115; 1863, vol xix., p. 261.

form, with a flat base and cutting edge all round, somewhat similar to a cast, in my possession, of one from the cave of Aurignac. All these were found either on or within two feet of the floor of the cave. They were imbedded in red earth, containing large stones, and enormous quantities of the remains of mammalia. Above the flint implements, in some places, were layers of comminuted bone and coprolites of hyæna; and in and around these was the greatest quantity of bones. These layers indicated old floors. I continued the excavations up to the year 1866, and the list of mammals which I have determined is second only to that of Kent's Hole. It comprises cave lion, cave hyæna, wolf, fox, badger, cave bear, brown bear, grizzly bear, urus, bison, Irish elk, stag, reindeer, mammoth, horse, *Rhinoceros tichorhinus*, *R. leptorhinus* of Owen, water-rat, and lemming.

There was clear evidence that the cavern had been inhabited by hyænas, and that the animals to which the remains belonged had fallen a prey to them. The traces of old floors above the flint implements prove that they inhabited it after the departure of man. Such as this is the evidence of the coexistence of man with the Pleistocene mammals, afforded by the contents of caverns in Britain. The small proportion which those caverns that contain the traces of man bear to those in which no traces of him have been found, shows that he was small in point of numbers as compared with most of the other animals.

Out of the thirty caverns explored in Great Britain, the contents of which I have classified, four only have yielded human remains; while out of forty river-deposits containing mammalia, only three have furnished any trace of man. Had man been very abundant in those days, we might certainly have hoped to have found his implements more widely spread, and especially as they were fashioned out of a material that is almost indestructible. That, however, he formed an integral member of the post-glacial fauna of the Pleistocene, is proved by the following table, in which I have arranged in order the animals found with man in old river-beds and in caverns, and the animals from river-beds and caverns in which he has not been found. The correspondence of these four columns show that the deposits from which the animals were derived are of the same geological age. The *Bos longifrons*,* which has been inserted among the British fossil mammals by Professor Owen, is purposely omitted, because there is no evidence that the animal was living at the time in Great Britain :—

* "Quart. Geol. Journ.," 1867, vol. xxiii. Brit. Foss. Oxen.

THE RELATION OF THE ANIMALS FOUND ASSOCIATED WITH THE REMAINS OF MAN IN THE CAVERNS AND RIVER DEPOSITS TO THE BRITISH POST-GLACIAL FAUNA.

	River deposits with remains of man.	Caverns with remains of man.	River deposits without the remains of man.	Caverns without the remains of man.
Homo, L.	•	•		
Rhinolophus ferrum equinum. Leach				•
Vespertilio noctula. Schreb.				•
Sorex moschatus. Pall.				
S. vulgaris. L.		•		
Talpa Europæa. L.				
Ursus arctos. L.		•	•	•
Ursus spelæus. Gold	•	•	•	•
Ursus ferox. Lew. et Cl.		•		
Gulo luscus. Sab.				•
Meles taxus. L.		•		•
Mustela erminea. L.		•	•	•
M. putorius. L.			•	•
M. martes. L.				•
Lutra vulgaris. Erxl.		•		•
Canis vulpes. L.		•	•	•
C. lupus. L.		•	•	•
Hyæna spelæa. Gold.		•	•	•
Felis catus. L.		•		•
F. antiqua. Cuv.				•
F. spelæa. Gold		•	•	•
Machairodus latidens. Owen.		•		•
Megaceros Hibernicus. Owen.		•	•	•
Alces malchis. Gray				•
Cervus tarandus. L.	•	•	•	•
C. capreolus. L.		•		•
C. elaphus. L.	•	•	•	•
Ovibos moschatus Bl.			•	
Bos primigenius. Boj.		•	•	
Bison priscus. Owen	•	•	•	•
Hippopotamus major. Desm.	•	•	•	•
Sus scrofa. L.		•	•	•
Equus fossilis. Owen		•	•	•
Rhinoceros leptorhinus. Owen.		•	•	•
R. tichorhinus. Cuv.	•	•	•	•
Elephas antiquus. Falc.	•	•	•	•
E. primigenius. Blum	•	•	•	•
Lemmus sp. Link			•	
Lepus cuniculus. Pall.		•		•
L. timidus. Erxl.		•		•
Lagomys spelæus. Owen		•	•	•
Spermophilus erythrogenoides. Falc.				•
S. citillus. Pall.			•	
Arvicola pratensis. Bell		•		•
A. agrestis. Flem.		•		•
A. amphibia. Desm.		•		•
Mus Musculus. L.				•

Such as there were, the animals with which the first man was surrounded, the mammoth, the horse, and the bison were most abundant; the reindeer was far more common than the red-deer, and that again than the roe. The Tichorhine rhinoceros was more widely spread than the Leptorhine, and the hippopotamus than the wild boar. The cave lion and cave hyæna, wolf and fox, were moderately abundant, while the badger and brown bear were comparatively scarce. Among them man appears for the first time in the world's history, scantily armed, and few in numbers, and by the exercise of that intellect which separates him from the rest of the animal world, asserted himself their king. His craft proved stronger than their strength, and his cunning sharper than their claws or teeth. In his time Great Britain formed part of the continent, and the Thames flowed northwards to join the Rhine and Elbe in forming an estuary in the latitude of Berwick. The climate, also, was so severe, that glaciers descended from the mountains of Cambria, Scotland, and Wales, and the reindeer and musk-sheep could live in the lowlands. Then all these conditions passed away, the land became depressed, until Britain was insulated, and the waves of the Channel rolled over what was before the great feeding-ground of the Pleistocene herbivores, and the climate became warmer, until the arctic mammalia were obliged to retreat northwards. Coincident with this was the disappearance of the characteristic Pleistocene mammalia from the restricted area of Great Britain, and with them all traces of the first man, who spread over France and Italy,* using the same implements, and therefore possessed of the same habits, passed away.

* This occurrence of implements of the Amiens and Abbeville type associated with the remains of extinct mammalia in Italy, is proved by the discoveries of M. Louis Caselli, President of the Society of Immaculate Conception, in the gravel of Ponte Mammolo.—*Correspondance de Rome*, 4th May, 1867.

THE AIR-VESICLES OF BLADDERWORTS (UTRICULARIA).

BY J. B. SCHNETZLER.

[In England we have, amongst our wild flowers, three Bladderworts—*Utricularia vulgaris*, or Bladderwort, growing in stagnant water; *U. intermedia*, a rare plant; and *U. minor*, or lesser Bladderwort; and many of our readers will be glad to repeat the observations contained in the following paper, which is translated from the "Archives des Sciences."]

The genus *Utricularia*, or Bladderworts, comprises aquatic plants found in the stagnant water of ditches, marshes, etc. The leaves are submerged, and divided into fine threads, furnished with vesicles, or utricles (*asci*), to which De Candolle ascribes the following characters:—

These utricles are rounded, and furnished with a species of movable operculum, or lid. In the youth of the plant, they are full of mucus heavier than water, and the plant, weighed down by them, remains at the bottom. Towards the season of flowering, the leaves secrete a gas which enters the utricle, and drives out the mucus, opening the lid for its escape. The plant is thus supplied with a quantity of air-vessels, which elevate it gradually, and cause it to float on the surface. The process of flowering takes place in the free air; and when it is finished, the leaves again secrete mucus, which replaces the air in the utricles, weigh down the plant, and cause it to descend again to the bottom of the water, where it ripens its seed in the situation in which they should be sown.*

In spite of the labours of Göppert,† Benjamin,‡ Schleiden,§ Schacht,‖ Reinsch,¶ there is not yet a complete agreement of botanists as to the origin and morphological signification of these aerial vesicles. Before the publication of the works cited, they were usually regarded as a modification of the parenchyma of the leaves, which follows the numerous ramifications of the veins, under the form of a narrow band, and which by dilating from time to time produced the utricles.

Schleiden, who studied the development of these little organs, saw them appear at the angles of the division of the leaf under the form of little bodies like horns (*cornets*), supported on short pedicels. The lower side of the horn, and the

* De Candolle, "Physiologie Vegetale," t. xi., p. 87.
† "Botanische Zeitung," 1847, p. 721. ‡ Ibid., 1848, p. 17.
§ "Grundzüge der Wissenschaft, Botanik," 388, iv. Auff.
‖ "Beitrage zur Anatomie," etc.
¶ "Denkschriften der K. Bair. Bot. Gesettschoft," 1859, B. iv. 153.

lower margin of its opening, which itself scarcely increased in size, developed themselves much more than other parts; so that the complete utricle formed a small rounded body, laterally compressed, prolonging itself on the upper surface or on one side of the pedicel, and producing on the other side an opening in the form of a funnel, projected into the interior of the utricle, and having its exterior aperture closed by a fringe of hair attached to the upper margin. The interior surface of the funnel is adorned with differently shaped and elegant hairs, disposed in regular order. All the interior surface of the utricle is likewise covered with hairs composed of two cells, each of which is prolonged into two appendages of unequal length (Schleiden, *loc. cit.*).

Benjamin explains the formation of these utricles by supposing an arrest of development in certain segments of the leaves; instead of elongating themselves, they increase in breadth; a constriction takes place, forming a narrow neck, and they appear as little globular bodies, attached by a short pedicel to the vein of the leaf. According to Benjamin, we can follow these phases of formation by examination of a single leaf from its base to its summit. The utricle, at first filled with protoplasm, becomes, by the rapid absorption of this fluid, a reservoir of air, and, stretching in all directions, gradually assumes its ultimate form, which somewhat resembles a stomach, the pedicel taking the place of the pylorus, and the opening of the caudiac orifice. The mouth of the utricle he represents as a valve opening inwards. . . .

Schacht regards those organs of the Bladderworts, which most botanists consider leaves, as leaf-bearing branches, which, in their young stages, are rolled up, like the fronds of ferns; under this crook, their leaves are formed in succession, and in their axils small conical bodies appear, composed of little cells, like the beginning of a bud. These small bodies soon exhibit at their rounded extremities little cavities, produced by an arrest of the development of their cells, the margins of which grow, and the little cellular body, at first sessile, afterwards exhibits a prolongation at its base in the form of a pedicel. The lateral walls of the young utricle develop more and more, and the air cavity becomes bigger, the margins of the lateral walls incline towards each other, and fold inwards, while the original aperture closes. The original opening is, in fact, a valve, formed by a fold of the margin of the aperture; and the beard which, according to Schleiden, closes the opening, is found later on the external surface. . . . Thus Schacht considers the utricles as modifications of the ramifications of the axis, and not of the leaves.

In April, 1867, I studied the formation of the utricles of

the lesser Bladderwort (*Utricularia minor*), in the Marsh of Jogny, below Vevey. Schacht, who studied the formation of the utricles in the common Bladderwort (*U. vulgaris*), admits their formation in the axils of the leaves, and considers them analogous to buds. We see, indeed, between the ramifications of the leaves little bodies appear, composed of conical cells, with their free extremities slightly rounded. These little bodies, at first sessile, soon raise themselves on pedicels, the cells of which afterwards differentiate themselves into an external layer, corresponding with the layer of parenchyma, which follows the veins of the divided leaves, while the interior cells of the pedicel put themselves in communication with the cells that form the tissue of the veins, of which they at last appear to be a continuation. Whilst the pedicel thus becomes a prolongation of a leaf segment, the little globular body which it supports appears to us as a portion of the parenchyma of the same leaf. The walls of the little cellular body, whose extremity becomes hollowed out as a little cup, continue to grow while those of the hollow remain stationary. They at length unite, and close the cavity.

In the utricles thus formed in the lesser Bladderwort, there may be seen, towards the so-called embouchure, certain prolongations, or feather-divided appendages, like the capillary segments of leaves, properly so called; so that a perfect utricle looks like an expansion of the leaf parenchyma, supported on a vein which prolongs and ramifies itself beyond the utricle. The end, at first open, afterwards closes by two unequal folds of the walls, and thus form a sort of funnel covered with hairs, at the bottom of which the folds show themselves as two dark bands, bearing linear hairs, while those at the mouth are usually capitulate.

If the utricles, at the commencement of their formation, show themselves at the angles of the leaf segments, their position is by no means constant, when we examine them at a more advanced stage, in which the leaf itself is modified. The "globules with pedicels" of Benjamin are often found a good way from the angles of the segments; on the lesser Bladderwort they may even be seen at the extremities of the leaf divisions. We cannot therefore infer from their position any analogy with buds.

From the foregoing remarks it will be understood that the "globules with pedicels" of Benjamin, and the small horn-shaped bodies of Schleiden, are only intermediate phases of the utricles.

An anatomical examination of the perfect utricle confirms this view. The walls of the utricle are composed of two layers of angular cells, which have at first a clear green colour. In

the intercellular canals small conical cells are seen at an early period, which terminate inside and out by a little rounded cell. The interior cell forms, at a later stage, the base of the quadrifid hairs spoken of by Schacht. This author does not mention the exterior cells, which are always seen in great numbers, even on the young utricles of the lesser Bladderwort, under the form of small flattened globes, which, at a subsequent period, are often split in two. These globules are also met with on other parts of the segmented leaves, when they appear like little mushrooms, with their stems buried in the cellular tissues. The external globule becomes filled in time with a brown substance. Schleiden* observed these flattened cells on the exterior of the utricles, but he does not mention those on the leaves; their presence on the leaf, properly so-called, appears to me an additional proof that the utricle is only a modification and expansion of the parenchyma. The quadrifid hairs which garnish the interior of the utricles bear some resemblance to the stellate hairs often found on the inner surface of the air-vessels of the water-lilies. The intercellular spaces of the leaves of the Bladderwort contain much gas, which makes them look black under the microscope; the black band thus occasioned is prolonged through a pedicel as far as the utricle. In plants exposed to light I have often observed a strong disengagement of oxygen gas, bubbles of which rose through the water for a considerable time, forming an almost continuous thread. These gas bubbles were disengaged at the angle of two leaf segments, not far from the utricle. Similar bubbles are also disengaged at the ends of the capillary segments of the leaves. As to the mushroom-shaped cells, of which the pileus, a little constricted in the middle, is often divided into two, they seem to me to occupy the place of stomata, and to act as glands. They exhibit, in fact, a great analogy with the glands often found at the base of viscid leaves of *Pinguicula vulgaris*, which terminate in a brown, rounded pileus, like that of a small mushroom, whilst the stems are colourless, like those of the Bladderworts. The mucilage which covers the surface of the leaves of *Pinguicula* correspond also with that which fills the cavity of the young utricles. We have already seen that the utricles exhibit at their commencement a very pale green colour, which, at a later period, becomes deeper. The Bladderworts taken from the Marshes of Jogny on the 18th of October, 1866, still exhibited a number of green utricles; but the greater part were dark violet or blue.

In these coloured utricles the angular cells of the interior layer, which are usually hexagonal, contain a coloured liquid,

* "Grundzüge," 4th Edition, 397.

passing from rose-lilac to violet-blue, giving the cells the aspect of painted glass, surrounded by silver threads. The cells which closed the intercellular canals were either red or dark blue, and surrounding them were other cells of reddish tint. At the same period I found in the segments of the leaves, by the side of green cells containing grains of chlorophyll, cells filled with a pale red fluid. The cells of the external layer of the utricles contained chlorophyll grains, grouped along their walls, whilst the interior was colourless. The cells of mushroom form had their buttons always brown.

The change of colour in the wall-cells of the utricles in which we see the green pass into rose, lilac, violet, and blue, depends evidently on a chemical action which has some relation to their contents and functions. It must be observed that the colouration of the interior cells is due to a liquid, whilst the granules of chlorophyll have disappeared, or did not exist. These granules appear to have been exposed to a dissolving action, and to an agency which has changed their colours. The red colour of cellular liquids is usually ascribed to a free acid, and the blue tint to the presence of an alkali. In the utricles of the lesser Bladderwort all the transitions may be seen, from bright red to dark blue. The cavity of the utricles contains at the beginning a mucilaginous liquid of a neutral reaction, and it is in this liquid that, at a later period, we see a little bubble of gas, which gradually increases as the liquid diminishes. We may easily satisfy ourselves of the presence of this liquid by changing the position of the utricle, when the gas bubble will be seen to reach the highest level by passing through a viscous matter, which opposes a certain resistance to its passage. In the month of June and July the vesicles are nearly filled with air. The plant then rises to the surface of the water, and the stalk which, in the lesser Bladderwort, bears from two to five pale yellow flowers, stands up in the air, and two unilocular anthers spread their pollen over the stigma of the pistil, out of contact with the water.

The ascensional force thus developed is very considerable. Reinsch* estimates the mean contents of a utricle as 2·57 cubic millimetres, and its weight as 0·6 milligrammes, and the ascensional force of a single utricle will be equal to 1,964 milligrammes. There are about 597 utricles on a principal stem, giving an ascending or floatation power of 0·778 grammes for an entire plant. Reinsch reckons a total of 4·44 grammes. (Reckoning four branches it would be 3·112 grammes.) Now the weight of the head of flowers which rise above the water is 0·295 grammes; there is thus a considerable excess of power capable of maintaining all the flowers above the water

* "Mickroscop."

at the period of fecundation. After this is completed the utricle gradually fills with liquid; the specific gravity of the plant increases, and it descends slowly with its fruit, sinking below the level of the water, and the seeds fall from their capsule in the soil in which they are to germinate. We find amongst authors a difference of opinion as to the position of the Bladderworts in the water before flowering. Some regard them as attached to the soil by slight roots; others, like Reinsch, consider them to be floating plants. They are at first really attached to the soil at the bottom of the water; but the air vesicles which develop on their leaves gently drag them out of the mud, and in this action I see the true use of the utricle, for the entire plant floats very well in the water, and rises to the surface.

I placed a tuft of Bladderwort while the vesicles were still green in a large vessel of water, and found this to be the case. The water snails in the same vessel eat up all the vesicles, and the plant still floated.

Bladderworts are not the only plants in which movements are produced by disengagements of gas. In *Hottonia*, *Aldrovanda* and *Trapa natans*, we observe at the flowering season slow movements which displace the entire plant, while in other aquatic species, such as *Nymphea*, *Vallisneria*, *Ranunculus aquatilis*, etc., it is only certain parts which elongate themselves. In the Bladderwort and *Aldrovanda* it is the air vesicles which diminish the specific gravity, uproot it from the soil, and cause it to ascend. In the *Hottonia*, air cells are found amongst the leaflets, and in the petioles of *Trapa natans* air cavities are formed before inflorescence.

Sometimes a plant cannot completely detach itself from the soil, and the grains of pollen are then preserved from contact with the water by another method, and one conspicuous instance may be cited of an evolution of gas, which, instead of moving the plant, plays a more direct part in the process of fecundation. In the Lake of Escoubous, at the top of the High Pyrenees, 2,052 metres above the sea-shore, a remarkable variety of *Ranunculus aquatilis* grows, and form extensive beds, anchored to the bottom of the water by rootlets, which push their way among a thick carpet of dark green tremelloid ulva. In this situation, contrary to the laws which determine aquatic plants to seek the free air to accomplish their inflorescence and reproduction, it remains constantly submerged, far from the banks, where the sharpness of the frosts might destroy it, and far also from great depths, where it would not find light enough for its growth. It spreads out its finely divided leaves, and its white corollas, gilt at the bottom, and the processes of fecundation and reproduction take place without moving

to the surface. An air bubble, produced by a vegetative process, is detained amongst the petals, and in this bubble the anthers deposit their pollen.*

The evolution of gas in close cavities, which we see in a certain number of aquatic plants, before the opening of their flowers, is evidently connected with what is called vegetable respiration. During this process, the plant not only takes carbonic acid from the air or the water; it absorbs oxygen at all parts, which combines with certain vegetable matter, and forms carbonic acid. The chemical action of solar light excites the decomposition of the carbonic acid, which is absorbed, as well as of that which the plant forms, the carbon being combined with the elements of water and nitrogenous bodies, while the oxygen is discharged. Stomata appears to play an important part in respiration, although, according to the researches of Duchartre, there is no fixed relation between the number and size of the stomata, and the quantity of gas which the plants disengage under solar influence.

In certain trees of a dry and coriaceous tissue, there is an inverse relation between the number of stomata and the feebleness of the gaseous evolution; but that which proves that the gas evolved by the plant does not come from the stomata only, is that we see it disengaged from the cells of the epidermis of the upper surface of leaves of plants which have no stomata in that position, when we plunge them under water. We have noticed a similar evolution of gases from the submerged leaves of Bladderworts. In aquatic plants which are entirely submerged, the leaves have no stomata, and absorption and exhalation take place from the whole surface of the epiblema. The experiments of MM. Cloez and Gratiolet show that the decomposition of carbonic acid by the green parts of submerged plants only takes place under the influence of light. In darkness, contrary to what takes place in aerial plants, no carbonic acid is produced. A certain temperature is also necessary for the process. It does not begin below 15° (C), when the temperature is increasing, and cannot continue below 10°, when it is decreasing. The gas evolved by the plant contains a little nitrogen besides the oxygen.

If we proceed to apply the preceding observations to the leaves of the Bladderworts, we find them in water which is usually very rich in carbonic acid, which is absorbed by the leaves; and, under the influence of light, oxygen, and a little nitrogen are disengaged. These gases are also found in the aeriferous canals which traverse the leaf segments, and they escape from different points as small bubbles. We have seen these bubbles escape through the walls of the utricles, which

* Guérin "Dict. d'Hist. Nat." *t.* viii. p. 465.

appear to oppose some resistance to their transit, and may be stretched in consequence. The utricles, floating freely in the water, become the seat of endosmotic and chemical actions, especially when the surrounding water has a temperature of from 16° to 15° (C). The utricles enclose at the beginning a mucilaginous liquid, in which a gas-bubble soon appears, and increases in size: this is the oxygen evolved under the influence of light and heat. The plant disengages itself from the soil, and mounts towards the surface; the secretion of gas becomes more abundant, and the flower-stems are raised above the water. The oxygen secreted in the air-vesicles seems to exercise a chemical influence in changing the colour of the cell-walls, which become rose, lilac, and blue. The colouration of the envelope affects the internal processes of the cell. We know that in organs not coloured green, like the petals of a flower, there is no evolution of oxygen, but an absorption of oxygen and an evolution of carbonic acid. This gas does not leave the utricle, but is probably assimilated there; the utricle becomes again filled with mucilage, and water which it absorbs augments in weight and causes it to descend. Thus the utricles have a respiratory as well as a hydrostatic function.

GRUITHUISEN'S CITY IN THE MOON.—JUPITER'S SATELLITES.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

We will now, in continuation of our subject, direct our attention to the region lying S. and S.W. of the great clefts recently described.—*Dionysius* (25), a small crater (14 miles across, Lohrm.), lying on the shore of the *M. Tranquillitatis*, and having perhaps 3800 f. of depth, or more than enough to hide the peak of Snowdon, is chiefly remarkable on account of its brilliancy, amounting to 7° for its interior, and 9° for its wall. Yet it is not to be seen in the earth-shine, probably, as B. and M. remark, on account of its small dimensions. It would be an interesting and not unpromising investigation, to ascertain whether this is the true cause, and attended with no great trouble, as it would not be difficult to select other small craters which are perceptible on the dark side, and whose magnitude would be comparable with that of Dionysius. I have never made the attempt, but trust some of my readers may have at once sufficient instrumental power and leisure to take it in hand. We have seen that changes of colour, of

which little explanation can be given, frequently come on with the advancing lunar day; and there is no antecedent improbability in the idea that similar periodical alternations may be in progress during the lunar night. *Dionysius* has been selected by Birt as a standard of magnitude among craters of a similar character.—*Ariadæus*, and *Ariadæus* a, are a pair of craters at the W. end of the great cleft which bears that name.* *Silberschlag*, a crater $9\frac{1}{4}$ miles across, and of $8\frac{1}{2}°$ of brightness, appears, with those already mentioned, in the diagram of this region in our August number. There also we shall find *Agrippa* (26), a fine ring, somewhat elliptical, 27 miles broad, carrying a peak S., and interrupted by a little crater N.; in the steepest parts its interior slope amounts to 60°; and it ranges on the W. 6900 f., and 1000 f. more on the E., above the interior. It has several terraces, and a central hill.—*Godin* (27) has a narrow but very steep ring of 8° light, equally deep with *Agrippa* (Schr. makes it deeper), and of a somewhat quadrilateral form: its breadth is 23 miles. It is connected with *Agrippa* by ridges running in an oblique S.S.W. direction, a peculiarity of which other instances might be given. Several very defined craters lie in the neighbourhood. E. of *Godin* we find a small but very brilliant crater, *Rhæticus* b, which attains 9° of luminosity. *Rhæticus* itself, which will be found in our recent diagram, is an irregular ring, chiefly distinguished as being bisected by the lunar equator, and as being one of the few spots to which both Sun and Earth may be vertical; all these being, of course, comprised in an elliptical area, whose centre is that of the Moon, and its boundary the extreme amount of libration (which is greater in longitude than latitude), as referred to the centre of the Earth (not to the observer's position, in which it may be increased by parallax). Very strange, certainly, would be the aspect of the sky to any one of ourselves, if we could conceive ourselves transported there;—the Sun describing a slow but cloudless course from rising to setting, through the vertical region of the sky, and often through the zenith itself; and the Earth oscillating around that point for a short distance successively in every direction—an enormous globe, waxing and waning with all the features of the Moon, and turning every part in comparatively rapid rotation to the eye of the spectator. The *Rhæticus* of

* It should have been stated in our last number that the minute prolongation of this cleft, noticed in p. 97 as having been discovered by Gruithuisen, has been seen on several occasions by Messrs. Birt and Freeman.—I may be permitted also to take this opportunity of rectifying two former mistakes, which have been obligingly pointed out to me by Messrs. Knott and Proctor. The first occurs in Int. Obs. vii. 134, where the R.A. of the Great Star of 1572 has been given at 4h. 19m. 57·7s., instead of 4° 19′ 57·7″ (= 0h. 17m. 19·8s.): the difference also from Hind should have been, not 3m. 10s., but 3′ 10″.—The other is in Int. Obs. x. 148, where, instead of *density* of the ring of Saturn, it should have been *mass*.

Riccioli, it should be observed, lies further E., but its name was transferred to this spot by B. and M., in despair of its identification. This, no doubt, may have been impracticable, so far as it depended upon the relief of the surface, and an apology is thus obtained in this case for a change, generally speaking to be avoided; but the original *Rhæticus*, which has only recently been recovered by Knott, is a grey opening among the luminous rays issuing from the S.W. side of *Copernicus* (30), and consequently only to be recognized, where B. and M., no doubt, did not think of looking for it, under high illumination. Three contiguous dark spaces of a circular form were figured here by Hevel, and denominated *Lacus Herculei*: from Riccioli they received the separate names of *Rhæticus*, *Stadius*, and *Dominicus Maria*, occupying respectively the E., S.W., and N.W. angles of the triangular area in which they are grouped. They are not difficult objects in the Full Moon, *Rhæticus*, in particular, which is the darkest, and is divided centrally by a more luminous ray; yet still they are now, especially the other two, so unimportant in character, being merely duller patches in a labyrinth of bright streaks, and so much less conspicuous than very many other anonymous objects, that a suspicion may reasonably arise, whether they were not, at the date of those early observations, of a more decidedly contrasted grey hue than at present. Should there be anything in this, it would of course involve a consequence of some interest—that the streak-system of Copernicus is, in this place at least, on the increase; and when we bear in mind the very small amount of our actual knowledge as to the local colouring of the Moon, we shall feel that attention may be suitably directed to this spot, where identification and comparison are proportionally easy. Instances may be given in which variations of brightness in high illumination are probable —*Linné*, and a bright spot in *Werner*, may be specified; and it is time that observers should take this curious point in hand. On the earth, analogous changes, no doubt, may be perceived, but they would result from that cultivation of which we have no suspicion in our satellite.

It is in this ancient *Rhæticus* that we are to look for one of the curious "rampart-works" discovered by Gruithuisen. His sketch, in the "Astronomisches Jahrbuch" for 1828, represents a comparatively regular white figure in a longish grey area, consisting of one vertical stripe, bent to the left at the top, where it terminates in a small hill casting a shadow; ending in something like a little crater, with internal and external shade, at the bottom; and crossed at an angle of about 60° by four similar bright streaks: the figure might have been worth copying, but that he complains, in the next volume, of its

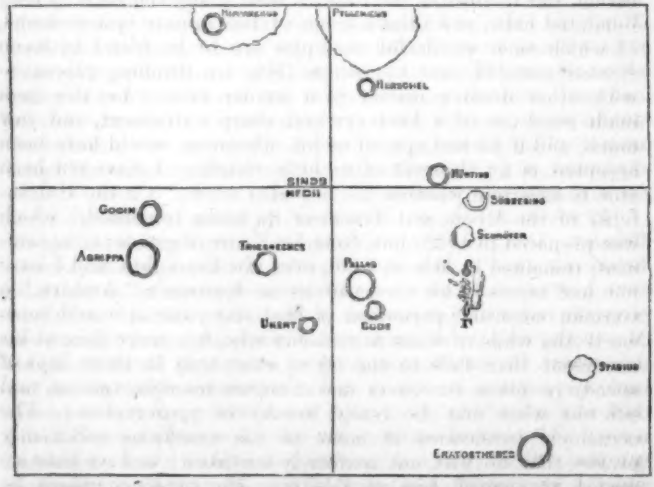
inaccuracy, there being one transverse line too many on W. side, and all of them being too bright: it had, he says, been very seldom visible, and "selenospherically obscured" for the last year. This astronomer assuredly thought, and published, an uncommon amount of nonsense. If we are to believe him, there is not a trace, ancient or modern, of volcanic action on the Moon, the so-called craters having been formed by the fall of enormous fragments from space (colossal aerolites), whose points still project above the once-plastic surface in the form of central hills. The Moon had been first a comet, then an asteroid, afterwards a satellite, and had been once covered with a primeval sea, deeper than its highest mountains, on whose features strong marks of degradation remain. He considers the clefts as indications of animal existence, and looks upon some of the smaller ones, which show no embanked edges, and may be 30 to 80 feet in depth, as being probably broad, straight clearings through forests, and forming connections of the nature of roads between all the fertile regions of the lunar surface. The "Selenites" themselves, he owns, we could hardly expect to distinguish individually on their journeys, but does not think it impossible that large bodies of them might be detected in these roads by their difference of colour, especially if meeting and separating again. The regular straight ridges which he describes he does not seem to refer to fortification, but inclines to the idea of their being the roofs of long inhabited halls, and thinks some of the minute crater-chains, of which such wonderful examples are to be found between *Eratosthenes* (29) and *Copernicus* (30), are dwelling-places:—with other dreamy matter of a similar kind. Yet this man made good use of a keen eye and sharp instrument, and saw much, and if he had spared us his inferences, would have been accepted as an observer of no little weight. I have not been able to ascertain whether his intended work, "On the Habitability of the Moon, and Traces of its being Inhabited," which was prepared in 1825, but, from his desire of greater completeness, remained in MS. in 1836, ever saw the light: and I have not had access to his observations in Kästner's "Archive," a German scientific periodical of that day; but it would seem worth the while of some astronomer who has more time at his command than falls to the lot of everybody in these days of speedy progress, to collect and compare his observations, and sift out what may be really worthy of preservation. The occasional verification of some of his assertions sufficiently proves that he was not uniformly mistaken: and we have no reason to suspect him of falsifying the evidence which he turned to such absurd account.

But it is time to return from the ancient *Rhæticus*, which,

in fact, lies beyond our proper bounds, to the spot so called by B. and M., with which we complete our survey of the First Quadrant of the Moon.

We commence the second, at the centre of the disk, with the *Sinus Medii*, G on our Index-map. This is an undefined tract of level ground, of little comparative importance, excepting from its lying in the visible centre of the hemisphere. It contains only two small craters, and a few short and low ridges; but varied illumination produces much change in its shading. From its position relative to the Sun and Earth, this is the point of the Moon which receives the greatest share of illumination; here, with the exception of a few polar summits, is the *minimum* of darkness, and eyes like ours would be able at all times (except during a total eclipse) to read writing of a moderate size. Here, too, the smallest possible margin is left for deception; the changes of libration and phasis have the least effect upon the prospect; and it is accordingly especially adapted for the study of those who make the discovery of physical change their object: it is unfortunate, our authors might have added, that the region is little marked by any interesting peculiarity.

Such, however, is not the case with the district lying E. and N.E. of it, some of the features of which are so curious, that the accompanying diagram is introduced to assist in its



identification. The Moon's centre is here indicated by the two crossing lines, of which that from right to left is the equator,

the other the first meridian. E. of this point we notice an imperfect ring, *Sömmering*, touching the equator: N. of this is a somewhat similar object, the *Schröter* of B. and M., forming the principal feature in "a labyrinthine mass, the complete disentangling of which could scarcely be successfully accomplished with the most powerful telescope. The countless multitude of hills which fill this landscape appears, even in favourable circumstances, almost like a mere fine luminous dust." Most of the elevations, however, show connection in chains, affecting a general parallelism with the tolerably distinct boundaries of the district, which consists exclusively of the minutest and most difficult groups. There is no great amount of elevation, especially for the Moon: some points in the outer border of the mass may reach 2600 f. The interior hills are very difficult of measurement: Γ, central, and by far the highest, may lie 2500 f. above a valley 9 miles E. The majority of the eminences range from 1000 down to 130 or even 70 f. The least visible of them lie eastward; but they are probably steep-sided, as, even when the detail is confused by too high an illumination, they never give the impression of a plain, notwithstanding their grey colour; and this tone may be due to the great multitude of minute and separately undistinguishable shadows. Craters are rare amongst them. Such is the account of B. and M., who add in a note, that notwithstanding their especial care, which they hope a comparison of their Map with the sky will prove, they could never perceive the slightest traces of the fortress-like ramparts which had been so much paraded for a length of time. Lohrmann, they add, had met with no more success; his figure, indeed, was very unlike theirs, but under the circumstances this could not be matter of surprise. L.'s design is certainly not merely very dissimilar, but poor in detail, and his complaints of difficulty are evidently very sincere.

If we now turn to the origin of these remarks, it is as follows. 1822, July 12, Gruithuisen discovered in the region before us what he considered to be a colossal structure consisting of regular and obviously artificial ramparts, to which he gave the name of *Schröter* (subsequently transferred by B. and M., when they could not find his object, to the crater so designated in our diagram). Its extent was about 23 miles each way, but it was very dark, and situated in one of the darkest parts of the Moon, and was visible only on the terminator. Its general outline accurately faced the points of the compass, there being a central ridge from N. to S., from which branched off at an angle of 45° on either side, a number of parallel walls, like the the veins of an alder or rose-leaf, running respectively S.E. and S.W. Those running S.E. flattened

gradually down: but those on the other side formed, with a second oblique rampart, lying as it would seem N.W. and S.E., enclosed spaces, which in his view would be thus sheltered from the N.N.W. polar wind. From 3 to 4 years later he and Schwabe detected external prolongations of several of these S.W. walls, that were in like manner stopped by another closing ridge. In 1826 Schwabe saw 5 fresh walls of this kind, some only of which Gr. could make out. The latter considered it remarkable that previous to the discovery of these new ramparts, a small ring was distinctly visible on their site, occasionally almost obscured by fog, of which not a trace could be subsequently perceived; and it was equally remarkable that in 1822 he always saw a small rampart completing the outline on the E., which afterwards disappeared, and beyond the E. ramparts a hill, the centre of 5 radiating ridges like a star, which have so totally vanished since, that the slight vestige of a roundish height alone remains. The regular figure itself he often found so covered with what seemed foggy clouds, that only unconnected traces of the ramparts could be seen, and the general form was lost; and such he supposed must have been the case at the time when Lohrm. drew the region before he heard of Gr.'s discovery. On the contrary the surrounding natural features have always remained the same; the high hill on the N. which terminates the central wall (Γ, of B. and M.); the somewhat smaller hill by which the great closing rampart running from S.E. to N.W. is cut off; and the little ring (a of B. and M.) in which the straight central rampart and the closing rampart terminate—though within this ring he had perceived many variations. Such was the curious figure which was at the time so celebrated in Germany, and which was seen by many continental observers, including Prince Metternich, who perceived it on the first news of its discovery, while "on the other hand the learned John Bull here went away empty, and behaved himself about it as his nature inclined him;" a somewhat ill-natured criticism, for which, however, there certainly was some foundation in the inattention of our observers; at the present day, it is satisfactory to feel assured that no such taunt could be with justice directed against us. This was the figure of which B. and M. could not find a trace, when they constructed their Map—though it is somewhat singular that the ridges which they have drawn on this spot are not unlike it in character—a circumstance which seems to have quite escaped them. At a later day, however, the comparative accuracy of Gr. as an observer was to be established, even on their own not very willing testimony. They state that, 1838, May 2 and 3, a long and hitherto vainly expected opportunity arrived of examining this curious region, in which, from the longitude and latitude

given by Gr., they concluded that his fortification was to be looked for; and this time, by means of the great Berlin achromatic of $9\frac{6}{10}$ in. aperture, they were successful. Two principal directions of the long ridges abounding in the district were very evident, one in the meridian, another intersecting it from N.E. in an angle of 50°. In the first direction are two low, but partially steep chains, bearing several insulated summits, which connect (a) and Γ at their ends; to the second belong, among others, 4 cross banks which connect these two chains by oblique lines, so as to enclose 5 longish valleys in succession, each about 9m. long by $3\frac{1}{2}$ wide. The uniform height of the side and cross walls, and the similarity in form and size of these hollows give an aspect of regularity to this figure, which is increased when they are filled with shadow, and the dividing ridges appear as bright, straight, narrow lines. It is, however, evident that we have only a product of nature in view. Many equally regular arrangements are to be found in the Moon, of which a remarkable instance has already been described in the environs of *Aristoteles*, and the magnitude of any one of these valleys is sufficient to include the greatest cities of the earth. (London, however, should have been excepted.) They further remark that a 3rd meridian chain (on E.) unites itself with the second (or central one), before it reaches Γ, and forms a valley with it, less precipitous than the others. Their diagram shows it also connecting itself with the central chain near its middle; and gives two strong prolongations, each composed of more than one ridge, of the oblique walls towards S.W. Thus the main features of the figure are well made out; the observers however have not stated, what must undoubtedly have been the case, that their own smaller instrument would have fully sufficed for the recovery of the object in a suitable position. It only remains for us to remark what has been seen in our own country.

The earliest verification, so far as I know, was effected by Knott, 1861, Mar. 19, when the details of B. and M. were very fairly caught with a $7\frac{1}{2}$-in. object-glass; and they were subsequently made out even at some distance from the terminator.—1862, Feb. 7, I had a good view of it with my $5\frac{1}{2}$-in. object-glass, with a power of 170, definition being flaring and unpleasant, but not bad. It was not very close to the terminator, which was then bisecting *Timocharis* (34), and grazing the E. edge of *Eratosthenes* (29). The central ridge connecting Γ and (a) was very apparent. E. of it I could distinguish little, but on the W. I was able to reckon 4 oblique walls, the first starting from Γ, to which a 5th very short one might be added close to (a), if I was correct in thinking that the central ridge branched out right and left at its N. end, instead of running

up to that ring. The whole agreed more with Gr.'s description than B. and M.'s figure, in the progressive shortening of the oblique walls, towards the N., so as to give fairly one-half of the design of a tapering leaf. But my remark at the time was, "the whole object looked coarse, and though curiously arranged, would never have given me the idea of an artificial production." The following night I could still make it out as a previously known figure, and could even count up four valleys in feeble relief. The crater (a) appeared to contain another interior ring, concurrent with the larger one on its E. side. The terminator lay at this time a very little beyond the E. end of *Clavius* (50), and wall of *Bullialdus* (60), and its own diameter beyond *Copernicus* (30). From this it appears that it is by no means a difficult object, and may be made out under much higher illumination than Gr. would have led us to suppose: and it is worth looking for, not merely for its curious parallelism, but still more as very suitable for studying the question, which after all seems open to further enquiry, of temporary atmospheric obscuration. It is situated in a region where the effect of variations in perspective foreshortening from libration may be neglected, and since none of the principal lines run in the parallel of latitude, there is little reason to anticipate illusion from the change of the direction of illumination due to the lunar seasons. Any permanent features ought, therefore, to be always equally visible in corresponding circumstances: the direct observations of the discoverer, and the fruitless searches of L., and B. and M., who not only examined but drew the region in detail, would lead to a suspicion that they are not so. Future study only can decide; and if it should be found that there are variations, not explicable by changes in the angles of illumination and vision, we must look further for the cause. The existence of a lunar atmosphere is denied upon arguments of much cogency; but the question cannot be considered as finally at rest; and the region before us may be found especially suited for its decision, since from its low-lying, and at the same time irregular and complicated character it may be supposed highly favourable for the exhibition of atmospheric influence. As such, its strict examination is commended to those who love to trace the footsteps of the Maker of all things in the manifold exercise of His creative power.

TRANSITS OF JUPITER'S SATELLITES.

Oct. 1st. II. egress, 7h. 26m., Ditto shadow, 9h. 8m.—3rd. III. egress, 7h. 51m. Ditto shadow ingress, 7h. 52m. Ditto ditto egress, 11h. 29m.—6th. I. ingress, 9h. 25m. Ditto shadow, 10h. 22m. I. egress, 11h. 44m. Ditto shadow, 12h.

42m.—8th. I. egress, 6h. 11m. II. ingress, 6h. 56m. I. shadow egress, 7h. 10m. II. shadow ingress, 8h. 55m. II. egress, 9h. 49m. Ditto shadow, 11h. 46m.—10th. III. ingress, 7h. 44m. IV. egress, 10h. 7m. III. egress, 11h. 22m. III. shadow ingress, 11h. 53m.—13th. I. ingress, 11h. 13m. Ditto shadow, 12h. 18m.—15th. I. shadow ingress, 6h. 46m. I. egress, 8h. 0m. Ditto shadow, 9h. 6m. II. ingress, 9h. 22m. Ditto shadow, 11h. 34m. II. egress, 12h. 15m.—17th. III. ingress, 11h. 20m.—22nd. I. ingress, 7h. 30m. Ditto shadow, 8h. 42m. I. egress, 9h. 50m. Ditto shadow, 11h. 1m. II. ingress, 11h. 50m.—26th. II. shadow egress, 6h. 22m.—27th. IV. shadow ingress, 9h. 21m.—29th. I. ingress, 9h. 22m. Ditto shadow, 10h. 37m.—31st. I. egress, 6h. 9m. Ditto shadow, 7h. 25m.

OCCULTATIONS.

Oct. 15th. f Tauri, 4 mag. 7h. 38m. to 7h. 45m.—16th. θ^2 Tauri, 4½ mag., 7h. 25m. to 8h. 9m. θ^1 Tauri, 4½ mag. 7h. 33m. to 8h. 80 Tauri, 6 mag., 7h. 55m. to 8h. 36m. 81 Tauri, 5½ mag., 8h. 6m. to 8h. 51m. 85 Tauri, 6 mag., 8h. 33m. to 9h. 27m.

THE LUNAR ECLIPSE OF SEPTEMBER 13.

BY JOHN BROWNING, F.R.A.S.

During this eclipse several facts were noted that, carefully considered, may, I think, tend to elucidate the interesting problem of the condition or constitution of the Moon's surface. Few questions are more interesting to astronomers, and few seem more difficult of solution.

It is because of their indirect bearing upon this question that I think the points I am about to describe merit particular attention. On the 13th of September the sky during the day was overcast, and it remained thick until shortly before nine o'clock. Then, quite suddenly, it became exceedingly clear, and remained so for the greater part of the night. After the very unfavourable weather astronomers have lately had to contend with, and the tantalizing obscurity which prevailed on the night of the disappearance of the whole of Jupiter's satellites, except in large telescopes, the effect of this almost unlooked-for clearness was most cheering. This exceeding clearness probably materially modified the results that were afterwards obtained.

According to calculation, the eclipse must have commenced

at 9.43, for at that time the Moon entered the penumbra of the earth's shadow; yet, three-quarters of an hour after this, no diminution of luminosity in the Moon could be detected.

At length, at about 10h. 30m., a slight shade was seen stealing gently over the Moon's disk, commencing at the limb in the N.E. quadrant. This shading steadily increased in intensity until eleven o'clock. At this time a darkening of the limb in the N.E. became distinctly perceptible. Three minutes earlier the Moon had entered the umbra of the Earth's shadow; still, though I was watching most anxiously at the telescope, I could not detect the exact instant at which this, the second stage of the eclipse, began.

The darkness kept creeping over the disk, veiling first one and then another well-known object, until it had covered about one-third of the Moon's surface. When it had reached thus far, many of the craters on the dark limb became distinctly visible. I noticed also that some of the ray-streaks *projected within the shadow*. At the maximum of eclipse, which occurred at 12.26, three-quarters of the disk seemed darkened; the exact amount was 0.693, the whole disk being 1.

The full disk of the Moon could at all times be dimly made out, the edge of its disk, even the portion most deeply immersed in the shadow, being much brighter than the other portions in shadow, and being, in fact, *encircled by a narrow line of light*. An observation in close relation to this was made during a late solar eclipse by a very careful observer, Captain Noble. This gentleman noticed that the limb of the Moon, though not the body, was visible, extending some distance beyond the solar disk. What is the meaning of this peculiar appearance? It seems the very reverse of what we might expect to obtain. At the time of an eclipse the Moon is in opposition, and it is, of course, at the full. Under these circumstances we might expect that the centre of the disk would be the most luminous, and that there would be a degradation of light towards the edges.*

The planets Mars, Saturn, and Jupiter also exhibit an increased luminosity at the edges of their disks. This is accounted for by supposing that they are surrounded by clouds. The whole matter would be explained if we could suppose that any vapour exists in the atmosphere of the Moon. Everything, except the appearance I have been describing, points to the contrary conclusion.

A peculiarity of the light reflected from the Moon's surface,

* This singular action of the edge of the disk appears to extend to the actinic rays. In one of Mr. Warren De La Rue's exquisite photographs of the full Moon, I noticed that some of the grey plains were continued to the edge of the disk. Frequently they almost touched the edge, but the extreme edge was always marked by a narrow line of light.

apparently in direct contrast with that to which I have just referred, is, that Mr. De la Rue finds that he cannot photograph with facility within some distance from the edge of the terminator. Objects that present the same luminous appearance to the eye as those in the middle of the illuminated portion of the disk, are yet only impressed with a very feeble degree of intensity upon the photographic plate.

Can these facts be of any assistance in reasoning upon the character of the surface of our satellite? For my own part I do not think any person who has been in the habit of observing the Moon with an instrument of large aperture will be able to accept the glacial theory.

When using a telescope of ten or twelve inches aperture, protecting the eye from the great glare by a single-reflecting prism solar eye-piece, the Moon's surface is seen to be almost entirely covered with markings of a considerable variety of tone and colour, many of these frequently changing in a few days, both in shape and hue. Even with an instrument of six inches diameter, some of these changes are easily perceptible.

During the late eclipse, I devoted especial attention to the colour of the Moon. It is a generally received opinion, that when the obscuration has proceeded to the extent of two-thirds or more of the surface, the obscured portion of the Moon appears of a strong coppery red, and that the edge of the shadow on the surface appears of a very decided blue.

In Mr. Norman Lockyer's translation of Amédée Guillemin's "The Heavens," and in Keith Johnston's "Atlas of Astronomy," diagrams of lunar eclipses are painted in chromolithography in the colours I have stated. My observations were made with Mr. Barnes's $10\frac{1}{2}$-inch silvered-glass speculum, furnished with a reflecting prism, and an achromatic eye-piece. During the whole time of the eclipse, I could never detect any trace of colour upon the Moon, except what I ordinarily see there. Looking through a four-inch refractor, I also observed the same freedom from colour just noted.

The colour stated to be seen on the part of the Moon under eclipse is usually ascribed to the refraction of some of the solar light as it passes through our atmosphere. I venture to suggest that, when the colour is visible, absorption plays an equally important part in producing it. This absorption would affect principally the blue rays of the spectrum, and it would be very small whenever our atmosphere is free from mist. Now, on the night of the 13th, as I have before said, the air was remarkably clear, and this may possibly enable us to account for the Moon's singular freedom from the colours which seem to have been observed upon it on previous occasions.

Still, as lunar eclipses are tolerably frequent, and, unlike solar eclipses, are visible over half the hemisphere of our globe, I cannot but conclude that such a total absence of colour during eclipses of considerable extent are very rare.

ON COLOURS SEEN DURING THE LUNAR ECLIPSE, SEPT. 13, WITH REMARKS ON THE PRECEDING COMMUNICATION.

BY HENRY J. SLACK, F.G.S., SEC. R.M.S.

It was with much surprise I heard from Mr. Browning that his views of the late lunar eclipse through Mr. Barnes's 10¼-inch telescope, so far from disclosing any decided chromatic effects, led him to express a positive opinion as to their absence. I watched the same eclipse at intervals through a telescope similar to that of Mr. Barnes's, with a silvered mirror, but of smaller size (6½-inch), and furnished like his with a right-angled prism, to direct the cone of rays to the eye-piece. On referring to my notes I find the following:—"As shadow came over Aristarchus, that crater remained visible, and rather bright, until shadow advanced to near Eratosthenes, when it required sharp looking for to see it. The shadow was inky purple, and the sky colour in the neighbourhood dusky red. As shadow passed over different portions of the Moon, the darkness varied considerably, being much less over highly-reflecting portions than over the seas, which became very dark. After twelve the eclipsed limb grew noticeably redder, and objects likewise became gradually more visible. The red, coppery tint chiefly affected the lower part of the obscured limb, but was visible further in, gradually blending with the inky tints presented by the umbra at its advancing edge. By twenty minutes past twelve the increased visibility of obscured parts very striking. 12.26, eclipse at its height, and visibility of objects in obscured parts much greater than at an earlier period. As the Moon passed out of shadow, a brightening took place in opposite directions at the two edges of the limb, and bluish tints of brighter hue became conspicuous, contrasting with the reds." I added to this, "Red colour less conspicuous in telescope than in opera-glass with two-inch lenses." My wife's report of what she saw generally agreed with mine, but she noticed a *greenish* tint at the beginning of the eclipse in the penumbra, and did not see the *blue* as much as I did towards its termination. I think her eye is more sensitive than mine to the peculiar

greens sometimes seen on the Moon, and which are very rarely distinct to me.

I should not have thought so much of the discrepancy between what we saw and what Mr. Browning saw about five hundred yards N.E. of us, if we had not ascertained by comparisons that our perceptions of colour and his are pretty much alike. Can it be that the difference arose chiefly from his employing a much larger aperture? And does the eye become insensible to small quantities of red, when accompanied by a good deal of white light? Presuming the Moon during eclipse to emit red and white, or whitish-yellow, light, the larger aperture would collect more of both, but it does not follow that *both* would look more intense to the eye; the red might be overpowered as the white light increased, although its *proportion* to the white light might be the same. My opera-glass, which is unusually free from chromatic errors, made the Moon look much redder than the telescope, and Mr. Barnes's instrument being much larger than mine might have still further diminished the red aspect.

In the presence of Mr. Browning I made several experiments with red objects under the microscope, such as transparent pieces of dark orange-red glass, a red leaf of a fuchsia, and a red postage-stamp. The glass, as a transparent object, changes hue considerably as the amount of white (or yellow white) lamp light thrown through it is varied. The postage-stamp goes through similar changes as an opaque object, being very brilliant, and something between blood-colour and magenta, in full oblique illumination, and turning deeper and with a different hue as the amount of incident light is decreased.

To return to the Moon, we noticed, as Mr. Browning did, the remarkable distinctness and light tone of the margin of the eclipsed portion.

THE ABYSSINIAN EXPEDITION.

BY PROFESSOR D. T. ANSTED.

THE expedition now leaving the shores of England, and the armed forces preparing to penetrate Eastern Africa from the side of India under the British flag, having for their primary object the rescue of a few Europeans (only three of them Englishmen) from the clutches of an African tyrant, cannot but add something to our knowledge of a district hitherto only visited by isolated travellers at long intervals. As the army is to be accompanied by a scientific staff to report on the

geography, geology, and natural history of the countries visited, there is the more prospect of at least some return for the blood that must be spilt, and the treasure expended in the attempt.

It is not proposed here to consider the political aspect of the question involved, but as most of our readers will probably be glad to have some general notion of the physical geography of the country, we venture to collect together in a few pages a brief notice as to what Abyssinia is like, when and by whom it has been traversed, what is its climate, what are its resources, and what may probably be the difficulties the expedition will have to meet and overcome. A little information of this nature will serve to prepare us for the more accurate and extended information we may shortly expect to receive.

Abyssinia occupies an extensive tropical plateau, lying, for the most part, between a narrow strip of low land, forming the south-western shore of the Red Sea, and the important eastern branch of the Nile called the Blue Nile, whose sources were visited by Bruce. It is a compact four-sided area, lying between 9° and 16° N. lat. and 35° and 43° E. long. The coast of the Red Sea fringing it, and now partly occupied by Turkey, is about 600 miles in length from the Straits of Bab-el-Mandel to the northern extremity of Abyssinia. The other boundaries are Nubia to the north and west, and the Galla tribes towards the south. Within the country there are numerous streams, all feeders of the Nile; those to the north entering far to the north by the Albara, one of its main tributaries, and those to the south running directly into the Blue Nile. There are two lakes, one (Lake Tsana or Dembea) about sixty miles long, full of islands and abounding with fish. This is near the south-western part of the country, and not far from Gondar, the capital. It is also close to the sources of the Blue Nile. It is surrounded by a wide expanse of flat lands highly cultivated. The other lake is less important for its size, and is said to consist of a large extinct volcanic crater.

The shores of the Red Sea are low, swampy, and unhealthy, but the breadth of the low land is small, nowhere exceeding 100 miles, and towards the northern part of Abyssinia not more than sixty. There are several bays and roadsteads along the coast, but they afford few good harbours for large vessels, nor are they much known. Of the whole number Massowah is considered to be the one most available for the purposes of the proposed expedition. It is situated almost at the northernmost extremity of the country, and is eminently unhealthy in summer, but fortunately the distance from safe and healthy highlands is extremely small.*

* Of modern travellers in Abyssinia, Bruce was one of the earliest and most adventurous. He crossed from Sennar on the Blue Nile eastwards to Gondar.

There are few towns of the smallest importance in Abyssinia. Gondar, once the capital, is believed to be abandoned. Sokota to the south-east, Angol and Antalo to the east, Axum to the north-east. These are names of towns that appear on maps, but seem hardly to admit of description. The population has been estimated at between four and five millions, but this is probably a gross exaggeration. The inhabitants are the degenerate descendants of a civilized people, partly Jewish, partly Arab, partly Egyptian, who have once been Christians and still call themselves so, retaining the forms of a Christian church with many Jewish and Mohammedan customs. They are governed by a tyrant, now well known to us by name as Theodore II. He was born in 1818, and has led a turbulent existence, his so-called subjects being often in rebellion.

Much of the eastern side of Africa consists of a vast elevated plateau. Towards the northern part this presents the appearance of a ridge or wall of nearly 8000 feet, rising immediately from the sea, and often rapidly. When the plateau is reached, which is generally not without some difficulty, there is no corresponding descent on the side towards the interior of the continent. The summit of this great elevation is not indeed level, but it is everywhere very far above the sea. It is, however, frequently intersected by wide and deep ravines, sometimes descending 3000 feet to river valleys, and such valleys are not only very numerous but characteristic of the whole country of Abyssinia. Their breadth is sometimes more than twenty miles. The lofty plateau is so broken, and the gorges so deep, so numerous, and so wide, that the traveller is induced to fancy that the intervening ridges are detached mountains, or mountain systems, and describe them accordingly. There is no doubt, however, that there are lofty mountains in the interior, rising to at least 15,000 feet. The plateau is to some extent covered with lava, and on the coast hot springs have been observed, no doubt connected with the presence of the same rock.

The climate of Abyssinia is universally described as moderate, and, indeed, pleasant, and, with few exceptions, healthy. The nights are very cold, and the days, especially in summer, are hot, but the heat is nowhere excessive. There are rainy seasons, and the summer is generally dry, but in this respect there seems also no excess. During the four first months of

Salt followed at the commencement of this century for the east coast, but did not reach far into the interior. Dr. Beke has made several trips from the east, and penetrated far into the country. Two Frenchmen, Ferrel and Galinier, reached Gondar from Massowah (Red Sea) by another route. Mr. Mansfield Parkyns did not reach Gondar, but crossed, after reaching Adoua (half way), to the Nile below Sennar. There have been other travellers, but these have been the most adventurous.

the present year, at Magdala, where our fellow-countrymen are confined, the heat at sunrise was never less than 41° Fah., the usual range being from 44° to 55°. At noon the lowest point reached in the four months was 57°, and the highest 84°, from 60° to 80° being the general range. At sunset the extreme range was between 51° and 67°. There was rain on 19 days only out of the 120, and then chiefly at night. The air was generally calm. The sky was slightly clouded during January, March, and April, but clear in February. As Magdala is quite in the south, far in the interior of the country, and stands on an elevation by no means excessive compared with the general plateau, this may probably be taken as a fair estimate of the general weather of the winter and spring. Nearer the coast the rains are probably heavier, and the temperature more excessive, but there is nothing to render it likely that any serious difficulties will be incurred, either from heat or malaria, during the dry season. In May, however, the heavy rains begin, and from that time to October the country is less healthy.

It seems to be determined, from observations made by actual survey, that the best point to enter Abyssinia for a warlike expedition from India will be the island and port of Massowah, near Annesley Bay. The island is described by Mr. Mansfield Parkyns* as "a mere rock of coral, scarcely a mile long, and half that in breadth, without a vestige of vegetation to enliven its bare face" (Vol. i., pp. 77, 80). The climate in summer is detestable. Moncooloo, on the mainland, is about four miles from the anchorage of Massowah, and somewhat cooler and less unpleasant than the island. From this place the first terrace on the way up to the great plateau of Abyssinia is reached at Ailat, a distance of twenty-seven miles nearly due west. The plain of Ailat is already nearly 800 feet above the sea, and is reached with comparative facility by a gradual rise to an elevation of 989 feet, and then a descent of 200 feet. Water is obtainable about half way from a natural spring, but may always be found by digging a few feet. This terrace of Ailat is about five miles broad, and covered in winter with the richest verdure. Here are hot springs, that have been used from time immemorial for curative purposes, and are still frequented.

Without going so far as Ailat, it is easier to enter the high lands by branching at a certain point, and then the road is well marked by a number of stations, not more than ten miles apart, as far as Kiaguor, sixty miles from Moncooloo, and on the main plateau of Hamozeya, above 6000 feet above the sea. About thirty miles beyond is a very healthy spot, with a very

* "Life in Abyssinia," 2 vols, 1853.

strange name (Koodou-felassy on the maps), where every natural facility is afforded for a depôt. From here also several roads diverge, and this is the spot to which supplies from the interior seem naturally to come. It may be regarded as an admirable place for a first rendezvous, and might be reached in nine days by an army from Moncooloo.

Adowa is the next station, and is fifty miles beyond. It is reached after crossing the valley of the Mareb, one of the smaller of the deep and wide gorges alluded to. Adowa is upwards of 6000 feet above the sea, and is comparatively large, being the capital of the province of Tigré; and from this town the communication beyond would have to be made under any circumstances, as the various roads from the coast, of which there are several, all converge to it. The information concerning the roads up to this point has been obtained with a special view to the expedition, and is quite definite. There is a much shorter route from the head of Annesley Bay by Mahio and Dixan, traversed by Dr. Beke, and a third route, travelled by M. Munziger, which also appears to be practicable.

Up to this point it is not probable that any serious opposition could be made to an advancing army, but from here to Magdala, whether by way of Gondar, following the track of Ferrel and Galinier, or by a route more to the east, followed by Dr. Beke, to Debra Tabor, there seems as yet no settled plan of route. The distance hence to Debra Tabor cannot be much less than two hundred miles by any route, and may be more. To reach it, either the Taccazy River must be reached and ascended towards its source, or the eastern tributaries must be crossed, and the towns, Abiyad (40 miles), Autolo (30 miles), Samrie (15 miles), and Sokota (40 miles), made successive stations. Under any circumstances, there remains a considerable extent of little known and unknown country to be got over before Debra Tabor is arrived at. It may be that, along this line, the supply of water may fail, but this is not probable, judging from what is actually known of the country.

Debra Tabor would seem to be an important station, and a healthy and convenient summer resort. It is a town, built on an escarped hill, or fragment of table-land, not very accessible. It has been the habitation of the king during many of the discussions relating to the captives, and would probably have to be reached and taken. At a place called Gaffal, three miles from the town or mountain of Debra Tabor, Mr. Rassam speaks of there being an "European quarter," but does not describe it. Beyond the escarpment, to the west, there is a vast depression in the plateau of nearly a thousand feet, to the level of Lake Tsana, a little to the north of which is Gondar.

Magdala, the place of actual imprisonment, is described as

fifty miles south-east from Debra Tabor, on a difficult road. It is on a plateau consisting of a small tongue of high land, about a mile long, and half a mile wide, level at the top, and only approachable from one extremity. A number of similar plateaux surround it, and they are described by Mr. Rassam as being formed (probably capped) with columnar basalt. They are separated from the country to the north by deep ravines and an intervening ridge, involving a double descent and rise within a comparatively short distance. There is reason to suppose that the way to Magdala from Sokota through the Lasta country, without approaching Debra Tabor, may be much easier and more accessible by an armed force than that described by Mr. Rassam as having been followed by him when obliged to go from Debra Tabor to the place of his present imprisonment in company with the king.

South of Magdala we are already in the country of the Gallas, well-known for their ferocity, and of Shoa, one of the most interesting countries of the Abyssinian highlands. It is not likely that the expedition could do more than reach and destroy a few of the hill forts, of which Debra Tabor and Magdala are examples. Nor does it seem that this task will be very difficult.

There is much natural wealth in Abyssinia. Dr. Beke describes good coal worked fifty miles from Gondar, to the west; and iron ore of extraordinary richness and excellent quality would seem to be so abundant in certain districts, that the whole country for long distances shows marks of it that cannot be overlooked. Copper also is talked of, although hitherto the localities where any available quantities may exist are not described. Gold is certainly abundant. Besides these and other metals, sulphur is plentifully distributed, and various salts are alluded to, some of which are present in vast quantities. The plains, enjoying different temperatures, according to their height above the sea, are capable of yielding crops to almost any extent, and the soil is almost universally good. Thus all the products of temperate, warm temperate, sub-tropical, and tropical climates appear united, and it is only for man to say what he desires to ensure possession.

The following extract from an able report by the late Consul, Walter Plowden, Esq., made to the Foreign Office in 1855, will show how rich is the country, and how melancholy the state in which it remains:—

"The flat lands round Lake Tana (Isana or Dembea) are kept as pasture for cattle, or partially sown with grain, but are adapted for the cultivation of rice, sugar-canes, and indigo.

"The cold plains and mountains are fitted for the productions of northern latitudes. The more temperate provinces

would yield pepper, spices, and coffee, and the hottest districts give crops of cotton. Barley, wheat, peas, oats, beans, maize, millet, linseed, saffron, and some grain unknown to us, are cultivated with little trouble. A small potato called 'dennich,' and the root of a very nourishing banana, form great part of the food of some districts.

"At present not a fiftieth part of the surface is cultivated, while Edjow and other provinces produce two crops per annum on the same ground.

"Fruit-trees—the plum, the orange, the lemon, and the peach—grow wild in the jungle; the vines are luxuriant, and the quality of the wine excellent. Numerous streams everywhere irrigate and adorn this agreeable land, whose rich meadows, lowing herds, sparkling waters, golden harvest, and shady trees often present a scene of European beauty to the traveller." ("Correspondence respecting the British Captives in Abyssinia, presented to the House of Lords, 1866, p. 7.)

NOTE.—It may be interesting to the reader to be reminded in a few words of the history of the quarrel between Abyssinia and England. It is as follows:—Captain Cameron succeeded Mr. Plowden as Consul at Massowah, in February, 1861. At that time civil war had broken out in the country. Early in 1863 a letter from King Theodore to Queen Victoria was received and forwarded, in acknowledgment of some present that had been sent to the king, on account of kindness shown to the late Consul Plowden; and an embassy to England from Abyssinia was suggested in this letter. It was not till May, 1864, that a reply was despatched from England, Mr. Rassam, then Assistant Resident at Aden, being appointed to convey it. In February, 1864, however, news had arrived in England that Mr. Cameron, with seventeen other Europeans (chiefly missionaries and their families), were imprisoned at Gondar. Mr. Rassam in due time reached the king, and obtained release of the captives in March, 1866. They were, however, almost immediately recaptured, and, with Mr. Rassam himself, have since been in close confinement at Magdala.

ARCHÆOLOGIA.

THE great archæological event of the month has been, doubtless, the opening of the BLACKMORE MUSEUM, IN SALISBURY. The munificent founder of this interesting institution, Mr. William Blackmore, is a native of the city of Salisbury, though he has been established during, we believe, the greater part of his life in Liverpool and London, where he has amassed the wealth which has enabled him to confer this great benefit on the place of his birth. In a very excellent address delivered on the occasion we are briefly describing, Mr. Blackmore gave a history of the formation of his museum. In a visit to New York towards the end of the year 1863, he found the remarkable collection of the primeval antiquities of the valley of the Mississippi, formed by two world-known American antiquaries and explorers, Mr. E. G. Squier and Dr. E. H. Davis, for sale and undisposed of, and he bought them. They had been well described

in one of the publications of the Smithsonian Institution, and Mr. Blackmore was well acquainted with their interest and value. This collection formed the nucleus of Mr. Blackmore's gatherings in archæological science; but as everything must have its limit, he gave his attention chiefly to a certain class of antiquities, which is now known by the not very good name of prehistoric, but would, perhaps, be better termed primeval. This was the term adopted at its commencement by the British Archæological Association for the earliest division of the archæological periods. It is hardly necessary to add that Mr. Blackmore's museum has become one of the most valuable collections of these primeval antiquities which are known to exist, and every one who looks over the catalogue of its contents will acknowledge that Mr. Blackmore pursued a wise judgment in restricting himself to a period, or rather, to a class. Had it been an indiscriminate collection of anything archæological that could be picked up, it would, perhaps, only have classed with the now numerous local museums which are almost unknown to science, but, as it is, it will be well-known to everybody that all who wish thoroughly to study the primeval antiquities of the western world, must go for their most valuable materials to the city of Salisbury. With so noble a museum in his possession, Mr. Blackmore was naturally anxious to prevent all chance of its being eventually dispersed by giving it some permanent habitation. Naturally, the British Museum presented its claim first; Liverpool, too, had many claims on Mr. Blackmore's consideration; but he resolved, we think rightly, on giving the work of, we may, perhaps, say, his affection, to the place of his birth. It is another example of that fine old mediæval feeling which has led so many great men to seek to identify by their munificent foundations their name with the town which gave them existence. We need only point to another example of this spirit in Mr. Joseph Mayer, who, in this same year, has transferred his own noble museum to the town of Liverpool. Mr. Blackmore has not only placed his museum in his native city, but he has built there a very handsome building, at his own expense, for its reception, and the conditions attached to the foundation are, that it shall be opened to the public without charge. The property is vested in three trustees, the founder, Mr. William Blackmore, his brother, Dr. Blackmore, and his brother-in-law, Mr. E. T. Stevens. One of the conditions of the trust is, that "should it be found that the people of Salisbury are insensible to the value of the museum, or indifferent to the means of study which it affords them, the trustees may, if they think fit, remove it to some place where it would be better appreciated and more thoroughly studied." This is a case which we think hardly likely to present itself. At present the museum is open free of charge every day in the week, except Saturday, from two to five o'clock P.M., and on Monday evenings from seven to nine P.M.

Some researches have recently been made on the site of the ROMAN LEAD-MINING WORKS, on the MENDIP HILLS, in Somersetshire. It appears that the Roman miners had nearly exhausted the mines in this district, and that modern mining has consisted chiefly in

extracting the rather large amount of metal left in the refuse of the Roman smelters, through their imperfect smelting. The Roman cinders were found to contain, as is the case in other parts of our island, where the Romans obtained lead or iron, large per-centages of lead, varying from five or six in the slime of old washings, to ten and even fifteen in the other refuse. A field of about fifteen acres, on the Mendip Hills, four or five miles above Blagdon, belonging to Colonel Mackenzie, of Clifton, was remarked for the circumstance that neither cattle nor sheep could live upon the coarse grass which grew upon it. It bore the rather significant name of the Town Field, which arose, no doubt, from the foundations of buildings found in some parts of it. Curiosity having been excited by these circumstances, the ground has been dug into in several places, and it was found that not only was the soil largely impregnated with lead, but lumps of very rich ore and pieces of manufactured lead were found in the earth. With this encouragement, the exploration was continued, and many articles of Roman manufacture were found, among which were enamelled bracelets, a couple of richly chased gold rings, and large quantities of broken Roman pottery of various kinds. It is further stated that there were also found pieces of pots into which they ran the lead, with portions of the lead on them, and some of the furnaces, built of stones, in which the ore was smelted. Two or three well-made drains were found three or four feet underground, intended, no doubt, to carry off the sewage from the houses. Much of the earth has been found to be so rich in lead that it will pay well for working, in the course of which we may expect further interesting discoveries.

A question has been raised as to the sepulchral character of the great CIRCLES OF STONES, such as STONHENGE, AVEBURY, etc., and Mr. William Cunnington, the well-known secretary of the Wiltshire Archæological Society, stating that he had made numerous excavations within the circles at Avebury, and found no traces of sepulchral interment, and that in Scotland similar searches had been made with the great circle known as the "Stones of Stenness," in Orkney, with a similar result. We would suggest that in both cases the search was made rather under a misunderstanding. Had there been any sepulchral deposit in any of the great monuments of this class, we presume that it would probably have been above ground, and not beneath—perhaps in something resembling a cromlech, covered by a mound, which in the course of ages has been, through some cause or other, cleared away. We should not advise digging in the expectation of finding an interment of human remains, but with the hope of finding some articles of man's making which may throw light on the date of the erection of the monument. We confess, however, that though the origin and design of these great monuments is still a profound mystery, we can hardly imagine, from their magnitude, that they are sepulchral.

Mr. Roach Smith has given, in his "Antiquarian Notes," in the "Gentleman's Magazine" for September, an account of the remains of ROMAN TOWNS IN FRANCE, which we strongly recommend to all readers. It is written in the clear and instructive style for which

that eminent antiquary is well known. These notes are the result of an antiquarian excursion in France, made during the month of August. At Champlieu, on the edge of the forest of Compiègne, are found the very remarkable remains of a town, the name of which is not known, with a theatre and temple, which have been entirely laid open, and have presented a very large collection of sculptures, and monuments of various descriptions, the more interesting of which are deposited in the great museum formed by the present Emperor, in the palace of Compiègne. Among these Mr. Smith points out agricultural implements in iron, utensils for cooking and other domestic purposes, personal ornaments in vast numbers, and especially the gilt leaden tickets for the theatre, at Champlieu just mentioned, which are circular in form, with figures of deities, and one or two inscribed with the word MEDIO and numerals, referring, as he supposes, to a central position in the grades of seats. At Mont Berny, near Pierrefonds, on the road from Champlieu to Soissons, another Roman town has been uncovered, and the ruins are again of a most interesting character. Mr. Smith calculates that the excavations already extend over about twenty acres, and this is only a part of the extent of the town. The rooms laid open, he says, may be reckoned by hundreds, some of large dimensions, many of middling size, but the far greater number small. The Roman name of this town is also entirely unknown. The objects found in the course of the excavations are deposited with those of Champlieu, in the museum of Compiègne. Mr. Roach Smith's excursion extended to Soissons, the *Augusta Suessionum* of the Romans, and to Laon, the *Lugdunum* of the Remi of Gallia Belgica.

It is perhaps worth our recording that early SEPULCHRAL INTERMENTS, consisting of cinerary urns of rather rude construction, sunburnt, and not made on the potter's wheel, have recently been found at Wavertree, near Liverpool. They are described as discoloured by smoke, as though burning matter had been put into them.

SEPULCHRAL DEPOSITS, undoubtedly OF THE ROMAN PERIOD, have also been discovered in digging for brick-work in a valley between Dover and Folkstone. They consisted of three urns, of rather unusual form, a skull, round which was a circlet of bronze, two tazzas, or cups, and a few brass coins of Severus, Constantine, and Posthumus. In one of the urns, which had been broken and mended with rivets before it was used for this interment, a bronze fibula was found. Another was ornamented with bands alternating with rows of knobs.

T. W.

PROGRESS OF INVENTION.

UTILIZATION OF WOOLLEN AND OTHER RAGS.—Hitherto, rags have been, with the exception of woollen, employed only in the production of paper, and other matters not constituting articles of clothing. Woollen rags have been formed into *shoddy*, a wool which has been rendered of an extremely short staple—and therefore is inferior as a material for textile fabrics—by the mode employed for tearing the rags asunder. A large amount of the shoddy found in commerce is little more than a woollen powder: yet there is no reason why the staple of the wool obtained from worn-out textile materials should not be nearly as good as it ever was, nor why the same wool should not be manufactured advantageously over and over again; in which case our stock of materials would, in practice, be greatly increased, and clothing, for the poor at least, be greatly and most beneficially reduced in price. Ingenuity has at length discovered a means of not only preventing the destruction or serious damage of a vast amount of wool, but also of disintegrating, without injury, other textile matters, and separating the woof from the warp, when this is desirable from their being of different colours or materials. After the fabric has been separated into threads, these are opened by suitable apparatus, so that the wool, or other fibre of which they are composed, is not broken or damaged. The contrivance used for the purpose is simple, and mainly consists of hooks judiciously ranged.

SUBSTITUTION OF AN ELECTRIC CURRENT FOR A FULMINATE, WITH FIRE-ARMS.—An application of electricity, more curious perhaps than useful, has recently been made in France. Instead of placing a fulminate within the cartridge, and thus rendering it liable to explode accidentally, a very fine platinum wire is inserted into it. This, by a simple mechanism, is connected at pleasure with two very minute galvanic batteries, which are enclosed in the stock, and becoming incandescent, explodes the powder. The arrangement acts extremely well; but, for various reasons, it does not seem likely to be ever employed in practice, except perhaps for artillery.

SCIENTIFIC MEETINGS.

The British Association met this year at Dundee, on the 3rd of September, and on the whole its proceedings were very successful, though its managers having mistaken the spirit of flunkeyism for that of science, had elected a President without information or attainments corresponding with his position, and the subject of their choice, the Duke of Buccleuch, was unable to prepare anything that could fairly be called an "address." One of the most important items in the Report of the Society related to the arrange-

ments which the Board of Trade have sanctioned, and by which the Kew Observatory becomes the centre of a system of observations, constituting a "Meteorological Department," to be supported by the Government, and to furnish materials for publication.

The Council of the Royal Society, on the 13th of December, 1866, nominated the following Fellows of the Society as the Superintending Meteorological Committee: General Sabine, Pres. R.S., Mr. De La Rue, Mr. Francis Galton, Mr. Gassiot, Dr. W. A. Miller, Capt. Richards (hydrographer of the Admiralty), Col. Smythe, and Mr. Spottiswoode; and on the 3rd of January, this Committee appointed Mr. Balfour Stewart as its Secretary, on the understanding that he should, with the concurrence of the Kew Committee of the British Association, retain his present office of Superintendent of the Kew Observatory.

It is proposed to have observatories in the following places: Kew (central observatory), Falmouth, Stonyhurst, Glasgow, Aberdeen (probably), Armagh, and Valencia.

Different branches of science were fairly represented in the different sections, the general arrangements being the same as last year, except that the Anthropologists, with whose shallow pretensions the public are now pretty well acquainted, were not allowed a separate section for their chief occupation of abusing the negro. In the Physical section, Dr. Moffatt detailed some experiments and observations on phosphorus, and stated that phosphorus in a non-luminous state did not produce ozone, and looking at the sea as the chief source of that substance, he asked if it could not be ascribed to marine phosphorous which seems a doubtful opinion. Mr. Spiller described the employment of superphosphate of lime in aqueous solution for the purpose of hardening Caen stone. It acts upon the carbonate of lime forming Badiker's salt, 2 Ca O, H0, P0, +4 Ag. The igneous rocks of Scotland formed the subject of Mr. Geikie's address in the Geological section, and Dr. Sharpey gave a slight sketch of sundry physiological investigations. In the department of Anatomy and Physiology, Dr. Richardson recounted his aumoniacal theory of the coagulation of the blood. The address of Sir Samuel Baker in the Geographical and Ethnological section contained nothing worthy of note. In the Economic Science section Prof. Levi read the report of the Committee on the Uniformity of Weights, Measures, etc., in which the completion of the mural standard was announced. The Committee recommend making the metrical system compulsory, at no distant period. In the Mechanical Science section, Mr. Fernie read a paper on the iron and steel shown at the Paris Exhibition. He thought England had not been surpassed by France in any department. He mentioned a process of stamping, by which a complicated article, composed of several pieces were welded together, and stated that one English house had specimens equal to the French. The manufacture of steel in large masses by Krupp, and the Bocenm Company, excelled anything of the kind done in England, the work of the latter being especially worthy of notice. Sir John Lubbock delivered an able address on the antiquity of man.

Mr. Glaisher presented the report on Luminous Meteors for 1866—7, in which, amongst much interesting matter with most of which our readers have been acquainted, it is stated that the August meteors which disappointed observers in this country, were seen in countless numbers in America, after midnight of the 10th. Amongst the remarkable meteors, the most curious seems to have been one seen by Prof. Thomson at Aberdeen, on the 14th November last, at 2h. 40.5s., A.M. The nucleus passed over α Tauri and disappeared without noise. Its diameter, $\frac{1}{4}$ of the Moon. Its train was pale yellow, and at first remained as a band of dense nebulous looking light, about half the diameter of the Moon. After two minutes the train wound about in a serpentine form, and after three minutes it had collected itself into a nebulous-looking cloud, which remained vividly distinct until four minutes, when it was obscured by a cloud. The same meteor was seen by Prof. Grant at Glasgow, Prof. Piazzi Smith at Edinburgh, and Mr. Barkas at Newcastle. On the 20th November, a large detonating meteor is reported to have been seen at Nashville, Tennessee, which made a tremendous report, rattling windows and shaking the wall. "If," says the report "it actually took place, it forms an interesting addition to the list." In the Physiological department, some curious facts were cited by Sir Duncan Gibb, who stated that of 4,600 healthy persons he had examined with the laryngoscope, the epiglottis was pendant instead of vertical. In some cases he found this formation hereditary. It led to a modification of the voice, tending towards a low tone in adult males, and preventing women from reaching the higher notes. In the department of Zoology, Sir John Lubbock read an interesting paper on the anatomy of Thysanura. The long leaps of these insects are taken by means of two long appendages bent under the body and forming a spring held by certain muscles under a small latch or catch. Directly this is released, the spring jerks back, and the creature is thrown upwards and forwards.

NOTES AND MEMORANDA.

THE NEWTON FORGERIES.—M. Chasles holds the extraordinary opinion that the quantity of the alleged Newton correspondence in his possession establishes its claim to authenticity. In opposition to M. Fougère and other French critics, who have detected the character of the letters, he brings forward comparatively trivial criticism on certain details of their objections. The age of Newton, and the date of some of the pretended letters, is quite sufficient to overthrow their claims, and so are the errors in the signature of his mother. M. Chasles declares that he will publish the documents, and that competent judges will do justice. It would surely be wiser first to remove the objections raised by Sir D. Brewster and M. Fougère. The first proves that Newton could not have done what is pretended, and the last brings strong reasons for considering the correspondence inconsistent with known facts concerning Pascal. M. Fougère says of the letters ascribed to different persons, "They agree together like false witnesses who have combined to stifle truth and obtain credit for falsehood."

THE EPIORNIS: THE GREAT BIRD OF MADAGASCAR.—M. Alf. Grandidier writes to the French Academy that his investigations in Madagascar tend to show that the Epiornis is really extinct, and, not as M. Isidor Geoffroy St. Hilaire hoped, still living in unknown parts of the island. Though perfect fossil eggs are rare, fragments are common. The oldest of the Antandrouis never heard of the bird, and they have no traditions of its existence; nevertheless, M. Grandidier does not think it has been extinct for any long period, as its remains are found in the most modern formations, whose development is still going on. "It existed," he says, "perhaps, at the commencement of our era, and as the country became peopled, it may have been quickly exterminated, like the Moa of New Zealand." M. M. Joly, describing an Epiornis's egg holding more than eight litres, belonging to M. Nau, states that that gentleman, who was for thirteen years a prisoner amongst the Hovas, and who traversed the island in all directions, considers the bird as totally destroyed, and the eggs are very rare. The Malgaches, he says, pretend that the female died after laying a single egg, and they consider the discovery of any remains of the bird to bode misfortune to the finder and to his family.

ACTION OF GREEN LIGHT ON PLANTS.—M. L. Cailletet details experiments on the influence of different coloured rays, and the decomposition of carbonic acid by plants. He observes that green light afforded unexpected results, whether this colour was obtained from a glass, vegetable leaves, or solutions. Under its influence carbonic acid is never decomposed; a fresh quantity of gas seems, on the contrary, to be produced by the leaves. When a glass containing pure air and a leaf was placed in full sunlight, under a green glass shade, after a few hours a quantity of carbonic acid was obtained, scarcely inferior to that which the leaf would have evolved in the dark. This experiment, he thinks, may explain the sickly condition of vegetation under large trees.

THE ABSORPTION OF OBSCURE HEAT.—M. Desains states (*Comptes Rendus*) that chloride of carbon is more easily traversed by obscure heat than sulphide of carbon, chloroform somewhat less, while benzine and glycerine, with a thickness of 0m. 01, almost entirely stops the heat radiated from a blackened sheet of copper, heated to 400° (C.)

BICHROMATE OF POTASH AND ALBUMEN. POLARISCOPE OBJECT.—Mr. Thos. D. Smeaton sends us the following note from Robe, S. Australia. The action of albumen in modifying crystallization and making polariscopes is well known, but the particular plan adopted by Mr. Smeaton will interest our microscopic readers:—"In trying some photographic experiments I had occasion to coat a glass plate with the solution used in the carbon process (bichromate of potash, gelatine, and white of egg); this was left to dry slowly, when it presented a beautiful crystalline appearance. From the edges of the plate, fine arborescent shoots spread towards the centre, ending in larger twigs, enclosing ovoid loops. These were sometimes filled in with a clear yellow, sometimes with a dark orange, and occasionally with a feather of crystals so delicate as to challenge microscopic examination. The evenness of the ramifications, the wonderful manner in which they avoid crossing each other, and the varied colouring, tend to make the experiment well worthy of repetition. The solution (being solid at ordinary temperatures) must be floated on warm; and as it is already on glass, all that is needed for the preservation of the specimen is to place it face downwards on a piece of paper rather larger than the glass, to turn the edges over, and to gum them down.

POISONOUS FISHES.—The *Annals Nat. Hist.* has a translation of a paper on this subject by M. Duméril, containing some curious particulars. Risso ascribes the unwholesomeness of the Courpata found at Nice to its feeding on a highly irritating species of the jelly-fish, *Stephenomia*. Many species of fish are poisonous at certain seasons, the Conger is said to occasion dysentery if eaten at the time of depositing its eggs, and the eggs of pike and barbel are efficient purgatives. The "yellow-bill sprat" of the Antilles, in some instances, has caused death, with frightful convulsions, in the space of half an hour; another *Meletta* (*venenosa*), is almost equally formidable. A Tetraodon found at the Cape is very dangerous, and others of the same family are poisonous; and an Anchovy found in the Indian seas (*Eugraulis balama*) will prove fatal when eaten, if the precaution has not been taken of removing the head and intestines before cooking.